OPPORTUNITIES AND CONSTRAINTS IN DEVELOPING BIOMEDICAL RESEARCH SPACE FOR TEACHING HOSPITALS

by

Thomas J. Andrews

Bachelor of Science
Cornell University
Ithaca, New York
1982

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE
MASTER OF SCIENCE IN REAL ESTATE DEVELOPMENT AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JULY 1987

Signature of Author_____
Thomas J. Andrews
Department of Architecture
July 31, 1987

Certified by_____
Marc A. Louargand
Visiting Associate Professor
Department of Urban Studies and Planning
Thesis Supervisor

Accepted by_____
Michael Wheeler
Chairman
Interdepartmental Degree Program
in Real Estate Development

OPPORTUNITIES AND CONSTRAINTS IN DEVELOPING BIOMEDICAL RESEARCH SPACE FOR TEACHING HOSPITALS

by

THOMAS J. ANDREWS

Submitted to the Department of Urban Studies and Planning on July 31, 1987 in partial fulfillment of the requirements of the Degree of Master of Science in Real Estate Development

ABSTRACT

The market for non-corporate medical research facilities was examined to determine if the participation of the private development industry is warranted. Research funding sources and their payment policies were described, along with the activities and priorities of the institutions which house medical research. A national market overview was provided, followed by case studies which surveyed the research components of several institutions and explored how they have acted to address their space requirements. Financial analysis was performed on several different occupancy scenarios to illustrate the varying impacts on institutional finances.

Some nonprofit institutions which perform medical research have leased laboratory facilities developed and owned by private real estate interests. The most likely institutional candidates for future leasing activity are those which have little development capacity on their campuses, are restricted in their access to capital funds, and have the ability to recover the costs of leasing from their research sponsors. Present federal policies for reimbursement of the indirect costs of sponsored research activities were found to produce financial incentives to the institution for the participation of an outside developer in a lease arrangement for laboratory space.

Thesis Supervisor: Marc A. Louargand

Title: Visiting Associate Professor
Department of Urban Studies and Planning

ACKNOWLEDGMENTS

The author wishes to thank all those who gave their time and knowledge so generously. This production could not have come about without your help. This paper is dedicated to Christine, to whom I owe my happiness.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EXHIBITS

Chapter I

INTRODUCTION

According to an April 1987 article in the Boston Business Journal[1], the city's academic medical centers were finding it difficult to enlarge their biomedical research capacity. The culprit, reported the BBJ, was the regional real estate boom of the 1980s, which has constrained the ability of the medical schools and teaching hospitals to expand their campuses. Some institutions had decided to lease offsite research facilities from developers, while others were very reluctant to do so. The article indicated that a shortage of expansion space would eventually threaten the city's preeminent position as a world center of biomedical research.

This paper will examine issues surrounding the present and future demand for non-corporate medical research space and look at the potential role of the private development industry in supplying that space. First, the major sponsors of medical research, who provide the funding for the investigators, will be briefly profiled. An overview of funding trends will be provided, as will an attempt to predict future patterns of support. Then, the performers of research, who consume the sponsors' funding, will be examined, with particular emphasis on the role of the academic medical centers. A discussion of the characteristics of a research facility will be followed by an overview of the national and regional development climate

related to medical research. Then a group of case studies will describe how Boston's medical schools and teaching hospitals have dealt with their research space needs. A series of financial analyses will show how federal reimbursement policies can impact institutional capital decisions. The paper will conclude with some observations and lessons for developers drawn from the case studies.

NOTES

1. Denaro, Deborah and Gendron, Marie
"Hospitals hurting for space"
The Boston Business Journal, p. 1, April 6, 1987

Chapter II

WHAT IS BIOMEDICAL RESEARCH?

Biomedical research involves the development of new diagnostic and therapeutic modes, advancement of medical technology, and improvement of drug therapy. Research activities increase understanding of disease processes and their prevention or alleviation, and include investigation into improved systems of health care delivery. Research activities can be conveniently divided into two types: one asks "what if" and the other "how to". "What if", or "basic" research, typically is conducted with no presuppositions about its relevance to a clinical problem. "How to", or "applied" research, seeks to create or improve a technique or an apparatus to achieve a predetermined end [1].

Biomedical research and development in the U.S. is conducted in several different arenas: in university science departments; in privately-funded charitable research institutions (such as the Howard Hughes Medical Institute); in the laboratories of commercial pharmaceutical companies; at the National Institutes of Health (NIH) in Bethesda, Maryland; and in the nation's medical schools and teaching hospitals. This paper focuses on the latter venue.

NOTES

1. Fudenburg, H. Hugh, ed. Biomedical Institutions, Biomedical Funding, and Public Policy, Chapter 2 New York: Plenum Press. 1983

Chapter III

WHO PAYS FOR BIOMEDICAL RESEARCH?

Table 1 below traces national support for health research and development over the decade 1976-1986. As part A of the table shows, the federal government, substantially through the National Institutes of Health, remains the largest source of funds for health R & D, providing about half of total support in 1986. The last decade has seen private industry's share of funding increase dramatically as a percentage of total support. By 1986 nearly 40% of all health R & D funds came from private industry, compared to less than 30% just ten years earlier. State and local governments have provided a consistent percentage of funding, while support from private philanthropies has declined to less than 5% of the total.

The broad mission of the National Institutes of Health is to "promote the well-being of citizens" by encouraging and supporting research that will lead to medical innovations. The 11 institutes of the NIH fall under the aegis of the Department of Health and Human Services (HHS), and are financed through a direct appropriation of public funds by the Congress[1]. About 12% of the NIH budget is spent on intramural research programs conducted on the Bethesda campus. NIH activities are structured around four major classifications: basic research, clinical application, technology transfer, and training of scientists. The NIH has been the mainstay of basic medical research support

TABLE 1
NATIONAL SUPPORT FOR HEALTH R & D BY SOURCE OR PERFORMER, 1976-1986
(Millions of Dollars)
Source: The NIH Data Book 1986

Sector			1978		1980		1982		1984 prel.		1985 est.		1986 proj.	
Total of A or B	5107		$6,264		$7,924		$9,303		$11,619		$13,106		$14,348	
A. BY SOURCE OF FUNDS	$	%	$	%	$	%	$	%	$	%	$	%	$	%
Government	3371	66.0%	4,182	66.8%	5,145	64.9%	5,528	59.4%	6,769	58.3%	7,604	58.0%	8,085	56.3%
NIH	2060	40.3%	2,581	41.2%	3,182	40.2%	3,433	36.9%	4,257	36.6%	4,828	36.8%	4,977	34.7%
Other Federal	999	19.6%	1,230	19.6%	1,541	19.4%	1,537	16.5%	1,830	15.8%	1,980	15.1%	2,197	15.3%
State & Local	312	6.1%	371	5.9%	422	5.3%	558	6.0%	682	5.9%	796	6.1%	911	6.3%
Industry	1469	28.8%	1,800	28.7%	2,466	31.1%	3,436	36.9%	4,378	37.7%	4,975	38.0%	5,638	39.3%
Private Philanthropies	267	5.2%	282	4.5%	313	4.0%	339	3.6%	472	4.1%	527	4.0%	625	4.4%
B. BY PERFORMER														
Government	904	17.7%	1,163	18.6%	1,439	18.2%	1,595	17.1%	1,901	16.4%	2,115	16.1%	2,226	15.5%
Federal	780	15.3%	1,032	16.5%	1,284	16.2%	1,448	15.6%	1,741	15.0%	1,943	14.8%	2,048	14.3%
State & Local	124	2.4%	131	2.1%	155	2.0%	147	1.6%	160	1.4%	172	1.3%	178	1.2%
Industry	1483	29.0%	1,680	26.8%	2,256	28.5%	3,016	32.4%	3,855	33.2%	4,332	33.1%	4,841	33.7%
Private Nonprofit	2461	48.2%	3,084	49.2%	3,728	47.0%	4,107	44.1%	5,180	44.6%	5,862	44.7%	6,359	44.3%
Higher Education	1945	38.1%	2,445	39.0%	2,987	37.7%	3,319	35.7%	4,149	35.7%	4,695	35.8%	5,062	35.3%
Other	516	10.1%	639	10.2%	741	9.4%	788	8.5%	1,031	8.9%	1,167	8.9%	1,297	9.0%
Foreign	259	5.1%	337	5.4%	501	6.3%	585	6.3%	683	5.9%	797	6.1%	922	6.4%

since the Second World War. Approximately 60% of NIH expenditures support basic research. Other important federal funding sources for health R & D include the Public Health Service, the Departments of Defense, Energy, and Agriculture, the Veterans Administration, and NASA[2].

Part B of Table 1 shows where the funds from Part A were spent. Private industry is now consuming over a third of all health R & D funds. The federal government remains an important research performer. The share of funds flowing to private educational institutions has declined slightly in the decade.

About half of these federal health R & D funds are awarded to institutions of higher education. One third is spent within federal research agencies, and the remainder goes to other nonprofit institutions or to industry.

The commercial pharmaceutical and biotechnology industries spend about 95% of their R & D funds in their own laboratories, although this percentage will very likely decline as universities and hospitals become more willing to collaborate with industry[3]. The commercial firms, who must achieve a return on investment for their shareholders, perform relatively little basic research, concentrating instead on applying research to marketable products or processes.

Other research funds are disbursed by charities such as the Robert Wood Johnson Foundation and the American Cancer Society. Some choose to spend their money internally on

their own research efforts, while others simply provide grants to university-based investigators, or donate funds for laboratory construction. Unfettered by the needs of stockholders, many philanthropic institutions choose to support the basic medical research that industry cannot cost-justify.

NOTES

1. Fudenberg, op. cit., Chapter 6
2. National Institutes of Health
   "The NIH Data Book 1986", Bethesda, 1987
3. Fudenberg, op. cit., Chapter 6

Chapter IV

THE FUTURE OF RESEARCH FUNDING

Because the scientific community, particularly that segment which conducts basic research, depends so heavily on the federal dollar, considerable hand-wringing occurs every year as the Administration proposes the federal budget and the Congress acts upon it. The Reagan Administration's Office of Management and Budget (OMB) has been particularly active in attempting to restrain health research funding and increase military R & D. Military research, if funded as proposed by the Administration, would consume 72% of total government R & D outlays in FY 1988, up from 50% when Reagan took office [1]. The Congress, however, has a long record of magnanimity towards the NIH. A news account of the NIH director's yearly budget presentation before the Senate appropriations subcommittee in 1986 concluded:

> Thus went the annual ritual in which the Administration proposes a parsimonious budget for NIH and Congress ups the request [2].

Sure enough, when the budget for FY 1987 was passed, the NIH had ended up with a 17% increase over FY 1986, almost $1.2 billion more than the Administration had proposed [3]. Some of these funds will be cut when the Gramm-Rudman deficit control measures automatically take effect, but the increase will remain very generous compared with funding for other research agencies. Also in 1986, OMB attempted to place a cap on reimbursement for indirect

administrative costs on federal research grants, but the science community was able to postpone this action[4].

As of this writing, FY 1988 funding is being debated, with the Administration once again proposing significant increases in military research programs, and the Congress likely to shift some of those increases to biomedical research[5]. The escalating battle to find a cure for AIDS will also surely demand incremental federal research funding. In the future, despite the realities of the federal deficit, one can imagine in the future a less defense-oriented administration favoring biomedical R & D over military research.

University and hospital research administrators interviewed for this paper were quite optimistic about the prospects for federal support of biomedical research. Even those who did not anticipate real increases in federal support were confident that their institutions would be able to garner an increased proportion of the federal pie because of the superior qualifications of their investigators.

Nearly all the administrators suggested that the recent trend of greater support from industry would continue or even accelerate. Although in 1986 only about 5% of industry R & D outlays went to contracts with universities or hospitals, some institutions were receiving significant volumes of funding. Massachusetts General Hospital, for example, received 18% of its $75 million 1986 research budget from commercial contracts[6]. A July 1987 article in

Fortune magazine described the fledgling biotechnology industry's reliance on R & D, and mentioned an agreement between Johnson & Johnson and the Scripps Clinic and Research Foundation. The agreement gives the big pharmaceutical firm first refusal for the rights to any commercial application of Scripps' health care research, in return for financial support[7]. Boston's Brigham & Womens Hospital recently hired a Vice President whose focus is to cultivate and expand alliances with industry. As part of her duties, she will negotiate licensing and research contracts for hospital investigators[8].

Another encouraging development for medical research is the increased support by the Howard Hughes Medical Institute (HHMI). Since the sale of Hughes Aircraft in 1985, the Institute has embarked on a massive expansion of its research laboratories. Hughes investigators now operate in 27 hospital- and university-affiliated labs around the country, with an annual budget in excess of $200 million and growing[9]. Prior to the Hughes expansion, funding from philanthropic sources had grown at a much slower rate than federal and industry support[10].

While it is certainly difficult to predict future levels of biomedical research support, it seems that those institutions who house research activities can be relatively confident that they are insulated against substantial cutbacks in funding. The Congress has long considered the support of health research, particularly basic research, to

be an important public policy. Industry is on the verge of achieving many significant breakthroughs and will continue to look to R & D to provide the needed competitive edge. Finally, private philanthropies are likely to maintain a fairly constant level of financial support for research performers.

NOTES

1. Norman, Colin
   "Budget Details Released"
   Science, Vol. 235, p. 628, January 23, 1987

2. Norman, Colin
   "NIH Gets a Friendly Hearing on Capitol Hill"
   Science, Vol. 231, March 21, 1986

3. Culliton, Barbara
   "Congress Boosts NIH Budget 17.3%"
   Science, Vol. 234, p. 808, November 14, 1986

4. Association of American Medical Colleges
   "1985-1986 Annual Report"
   Journal of Medical Education, Vol. 62, #3, Mar 1987

5. Culliton, Barbara, op. cit.

6. Conversation with Lawrence Martin
   Associate General Director, Mass. General Hospital
   July 9, 1987

7. Gannes, Stuart
   "The Big Boys Are Joining The Biotech Party"
   Fortune, July 6, 1987

8. "BWH researchers find industry can be a valuable ally"
   Boston Hospital News, April 1986, p. 32

9. Culliton, Barbara
   "Hughes Settles with IRS"
   Science, Vol. 235, p. 1318

10. "The NIH Data Book 1986", op. cit.

Chapter V

WHO PERFORMS BIOMEDICAL RESEARCH?

Most federal grants for medical research are "investigator-initiated". That is, they are awarded to a scientist or physician who has proposed a specific study. The proposal undergoes rigorous peer review to verify its scientific and technical merit. Investigators usually have an institutional affiliation such as a faculty or clinical appointment at an academic medical center or employment at a corporation or research institute. Grants are awarded to the investigator in the name of the institution. The institution houses the research activity, and is reimbursed for its related costs by the sponsoring agency.

Under 10% of NIH funding goes to research contracts, whereby the sponsoring agency decides the scope and direction of the investigation in advance[1]. Ten years ago, this percentage was significantly higher, but the scientific community has persuaded the Congress that investigator-initiated research is a better use of the federal dollar.

Industry-funded research is usually directed by strategists within the corporation. That which is not performed by employees of the firms is contracted out to university- or hospital-based investigators. Many of the commercial firms, however, set aside some of their R & D budgets for basic research in their own labs.

NOTES

1. "The NIH Data Book 1986", op. cit.

Chapter VI

THE ACADEMIC MEDICAL CENTERS

Academic medical centers are integrated units comprising a medical school and one or more additional health education programs and associated teaching hospitals. The center's role is fourfold: it is the principal place for educating physicians, dentists, nurses, pharmacists, and other health care professionals; it provides technologically advanced or complex medical treatment not available in community hospitals; it is the chief source of primary care for the uninsured and economically disadvantaged in the inner cities; and it plays a unique role in medical research and in the application of that research to new diagnostic and therapeutic techniques[1].

There are 126 accredited institutions offering degrees in medicine in the United States. Of the 6000 or so hospitals in the country, 430 are members of the Council of Teaching Hospitals (COTH) of the American Association of Medical Colleges[2]. Although hundreds of other hospitals have residency programs and assist in the training of physicians, COTH members are the major teaching affiliates of the medical schools. Their distinguishing characteristic is a three-legged commitment to patient care, medical education, and research. Indeed, virtually all clinical investigation (research directly applicable to patient care) is performed in these teaching hospitals.

Medical schools, which are units of universities or

university systems, receive their income from a variety of sources, including tuition and fees, grants and contracts, patient care reimbursement from the faculty medical practice plan, gifts, endowment earnings, and government subsidy[3].

Independent teaching hospitals, like all hospitals, generate most of their income through their patient care activities. Third-party payors such as Medicare/Medicaid and the private health insurance carriers provide most of the reimbursement. The recent switch by these payors from retrospective payment, where the hospital recovers all of its expenses, to prospective payment (PPS), where the reimbursement is stipulated in advance based on national cost standards, has forced hospitals to be much more cost-conscious in their behavior. Additionally, PPS has drastically reduced the average length-of-stay for patients, producing a glut of hospital beds and generating intense competition between hospitals for patients[4].

Teaching hospitals, with higher than average cost structures, were hard hit by the switch to national standards. Reimbursement to the hospitals for their indirect costs related to graduate medical education is now likely to be fixed at low rates, partially to restrain the system from producing too many physicians. Furthermore, patient care income from third-party payors cannot be used for research funding. From a financial standpoint, the research function of a teaching hospital is intended to stand apart from the patient care and teaching functions[5].

NOTES

1. Stark, Nathan J.
"Academic health centers: an uncertain future"
Hospitals, August 20, 1986, p. 104

2. American Medical Association
"Survey of Teaching Hospitals 1985"
JAMA, Journal of American Medical Association,
September 26, 1986

3. Eastaugh, Steven R.
Medical Economics and Health Finance, Ch. 11
Boston: Auburn House. 1981

4. Conversation with Professor Gerard Wedig
Boston University School of Management
June 30, 1987

5. Conversation with David Shabot
Massachusetts Hospital Association
June 16, 1987

Chapter VII

THE ROLE OF RESEARCH IN THE ACADEMIC MEDICAL CENTERS

Like their colleagues in other sectors of academia, medical educators are expected to engage in research activities as part of their professional responsibilities. Such research, it is hoped, will add to the body of scientific knowledge, while enhancing the skills of the investigator and his or her students. Furthermore, publication of research findings will bring recognition, from peers and perhaps from the public, to the investigator and to the institution.

It is widely held in the academic medical community that the presence of a research function enhances the quality of care available to patients. Competition is keen among the hospitals as they seek to attract and retain noted physicians and researchers, who will in turn attract patients seeking the best of medical care. The sentiment expressed in the following statement, from a recent hospital master plan, is typical:

> In order to maintain its position on the leading edge of medical innovation, and to retain and attract highly qualified clinical faculty, the Hospital must develop a teaching and research reputation comparable to its reputation for providing outstanding clinical care[1].

NOTES

1. M. Bostin Associates, Payette Associates
"Master Plan for New England Deaconess Hospital"
Submitted to Boston Redevelopment Authority, May 1987

Chapter VIII

HOW THE MEDICAL CENTERS GET PAID FOR DOING RESEARCH

Since the federal government is the financial sponsor for the majority of non-commercial biomedical research, the method of reimbursement established by the Office of Management and Budget (OMB) is extremely important to the hospitals and medical schools[1]. The federal government is known as a "full" or "100%" reimburser. That is, OMB recognizes all direct and indirect costs associated with each research grant, and allows the supporting institution to be reimbursed for those costs. Calculation of direct costs related to sponsored agreements is straightforward. However, the definition of indirect costs, and the method for allocating those costs, has important implications for capital decisions related to research space.

Direct Costs

Direct costs are those costs identified specifically with a particular sponsored project, including compensation and fringe benefits of employees assigned to the project, cost of materials and supplies used in the research, services and travel costs incurred, and costs of subgrants and subcontracts related to the project. The grant applicant estimates the direct costs of the investigation. The sponsoring agency either approves or adjusts the requested amount. Direct cost expenditures in excess of the amount awarded are not recoverable from the sponsor.

Indirect Costs

Indirect costs are those costs that are incurred for common or joint objectives and which therefore cannot be identified readily and specifically with a particular sponsored activity. These costs include depreciation and use allowances, operation and maintenance expenses, and various administrative expenses. After awarding an amount for direct costs of an investigation, the sponsoring agency adds on an indirect cost award based on the indirect cost rate used by the institution at which the grant will be performed.

The Indirect Cost Rate

The indirect cost rate applicable to the research function of a teaching hospital or medical school is re-established annually. The rate, usually expressed as a percentage of the total direct costs, is calculated prior to the start of the fiscal year by the institution. An auditor from the cognizant agency (different federal agencies are assigned to monitor different grantee institutions: for example; M.I.T. is monitored by the Department of Defense; HHS monitors hospitals) will assure that OMB guidelines have been adhered to. At the end of the year, after actual allowable costs are known, the rate is recalculated. If the sponsoring agency over- or under-reimbursed the grantee institution, the subsequent year's rate would be set artificially low or high to balance the payments.

Depreciation Allowance

Institutions are compensated for the use of their buildings and equipment in sponsored agreements through a depreciation allowance, which is calculated into the indirect cost rate. The computation for the depreciation allowance is based on the acquisition cost of the asset, not including cost of the land. The asset is then depreciated on a straight-line basis over its useful life. Typically, building shells are depreciated over 40 years; interior building fixtures and finishes over 20 years; and major movable equipment over an average of about 8 years.

Rental Costs

Rental costs of buildings and equipment are allowable in full as indirect costs for both hospitals and educational institutions, provided that the lease is a prudent, "arms-length" transaction, and does not create a "material equity" in the property for the institution. A material equity exists when the lease:

(1) is noncancelable, and
(2) has one or more of the following characteristics:
(a) Title to the property passes to the institution at some time during or after the lease period.
(b) The term of the lease corresponds substantially to the estimated useful life of the property.
(c) The initial term is less than the useful life of the property and the institution has the option to renew the lease for the remaining useful life at substantially less than fair rental value.
(d) The property was acquired by the lessor to meet the special needs of the institution and will probably only be usable for that purpose and only by the institution.
(e) The lease has a bargain purchase option.

A lease which creates a material equity is considered to be a "capital" lease, essentially an installment purchase. Rental costs for a capital lease are reimbursable only to the amount allowed had the institution purchased the asset on the date the lease was signed. Similarly, rental costs on "sale and lease-back" arrangements are reimbursable only to the amount allowed had the institution continued to own the property.

Assignment of Indirect Costs

Institutions are allowed some flexibility in determining their indirect cost rate. Since indirect costs can vary substantially between different facilities in the same institution, separate indirect cost pools might be established for each facility. For example, New England Deaconess Hospital might have differing indirect cost pools for its Cancer Research Institute, its Shields-Warren Research Building, and its leased facilities on Burlington Street. A possible budgeted reimbursement scenario for the three facilities is shown below.

	MODIFIED TOTAL DIRECT COSTS	INDIRECT COST RATE	TOTAL FEDERAL REIMBURSE-MENT
Cancer Research Institute	$2,000,000	52%	$3,040,000
Shields-Warren Building	1,000,000	55%	1,550,000
Burlington St. Labs	2,000,000	60%	3,200,000
Totals	$5,000,000		$7,754,000

Note that if an unbudgeted award caused the Cancer Research Institute's direct costs to increase by $500,000, the indirect cost reimbursement would increase by $260,000 ($500,000 x .52). Actual indirect costs would increase only slightly, however, resulting in an overpayment that would have to be adjusted for in the following year's rate.

An alternative technique for the hospital would be to have all its indirect research costs reimbursed at the same rate, based on the total direct and indirect costs for the institution.

Interest Expense Reimbursement

An important distinction between hospitals and educational institutions is made in the reimbursement regulations published and enforced by OMB. Traditionally, federal sponsors did not allow interest expense to be included as part of indirect cost reimbursement. In 1982, educational institutions, including medical schools, succeeded in having their cost principles (OMB Circular A-21) revised[2]. Following the revision, educational institutions would be reimbursed for the costs of financing new buildings, remodelings, or capital equipment, "provided the total cost (including depreciation or use allowance, operation and maintenance costs, interest, etc.), does not exceed the rental cost of comparable assets in the same locality". Hospitals and other research performers not owned by educational institutions received no such revision to their regulations.

Deviation from Interest Expense Exclusion

Recently, a few hospitals have received reimbursement for interest expense after enduring a "deviation procedure". The hospital must persuade the cognizant auditor that it is in the government's best interest to reimburse the institution for financing costs[3]. Because no regulations are in place to guide the auditors in their decision-making, and since there are only a small number of precedents, it would be unwise of any hospital to commit to debt financing before going through the deviation procedure and securing an agreement from the government to reimburse interest costs.

Reimbursement Policies For Other Funding Sources

Funding sources which are not federal grants may have widely differing reimbursement methods. Federal contracts, for example, might be awarded on a bid basis and carry a predetermined indirect cost payment rate. Commercial contracts are negotiated between the parties. In the past, industry had been willing to pay only the direct costs of research they sponsored at institutions. Nowadays, most research performers seek to be fully reimbursed for direct and indirect costs, usually at the federal rate. Funds from foundations or gifts may be unrestricted or might have very specific use stipulations. Institutions with a superior research reputation are able to negotiate more favorable reimbursement arrangements from non-federal supporters.

NOTES

1. Office of Management and Budget
"Circular A-21--Cost Principles for Educational Institutions"
Federal Register, Vol. 44, No. 45, March 6, 1979

2. Office of Management and Budget
"Circular A-21--Cost Principles for Educational Institutions"
Federal Register, Vol. 47, No. 149, August 3, 1982

3. Conversation with Walter Boland
Office of the Regional Director of Department of Health and Human Services
July 14, 1987

Chapter IX

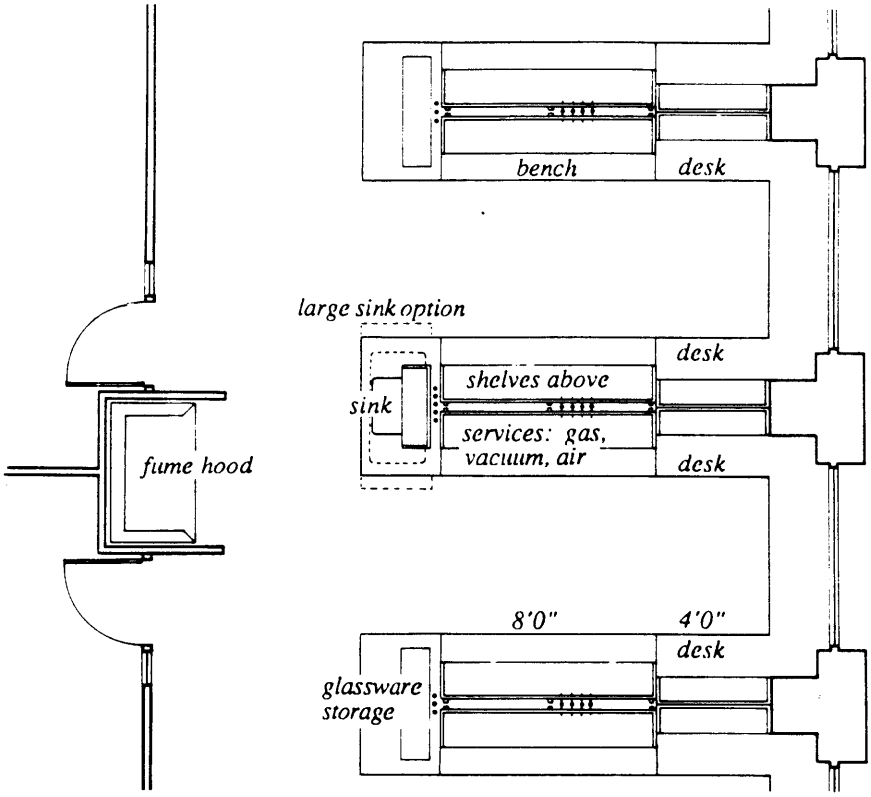
THE MEDICAL RESEARCH FACILITY

The editor of a recent text on laboratory design stated that three key issues must be responded to in the design process[1]. First, flexibility must be achieved, to the extent possible, because of the unpredictable changes in needs which will occur over the life of the facility. Second, the building occupants and the surrounding community must be protected from the explosive, toxic, or otherwise hazardous materials which may be present in the facility. Finally, providing a quality work environment for the occupants will greatly aid the institution in attracting and retaining scientific personnel. These challenges are as true for retrofitted facilities as for new construction. Because of the complexity of this building type, a developer must be certain to hire professionals and consultants with experience in laboratory design.

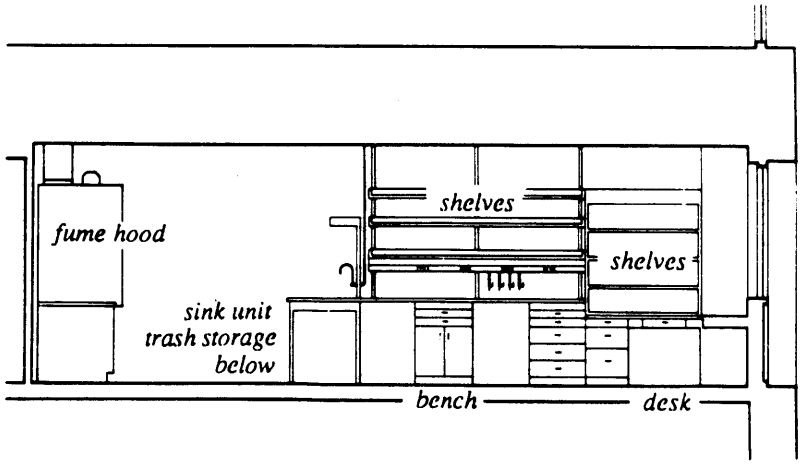
The basic laboratory module, with its ergonomically appropriate dimensions, has become fairly standardized over time. Figures 1 and 2 below show the generic module in plan, elevation, and isometric. A 20- to 24- foot wide bay contains benches, desks, shelves, work sinks, and one or more fume hoods for up to four investigators. Current research practice favors an open plan whereby laboratories open directly to adjacent labs and to corridors where researchers share equipment and support rooms. This concept facilitates a high degree of interaction among individual

FIGURE 1

Generic laboratory plan

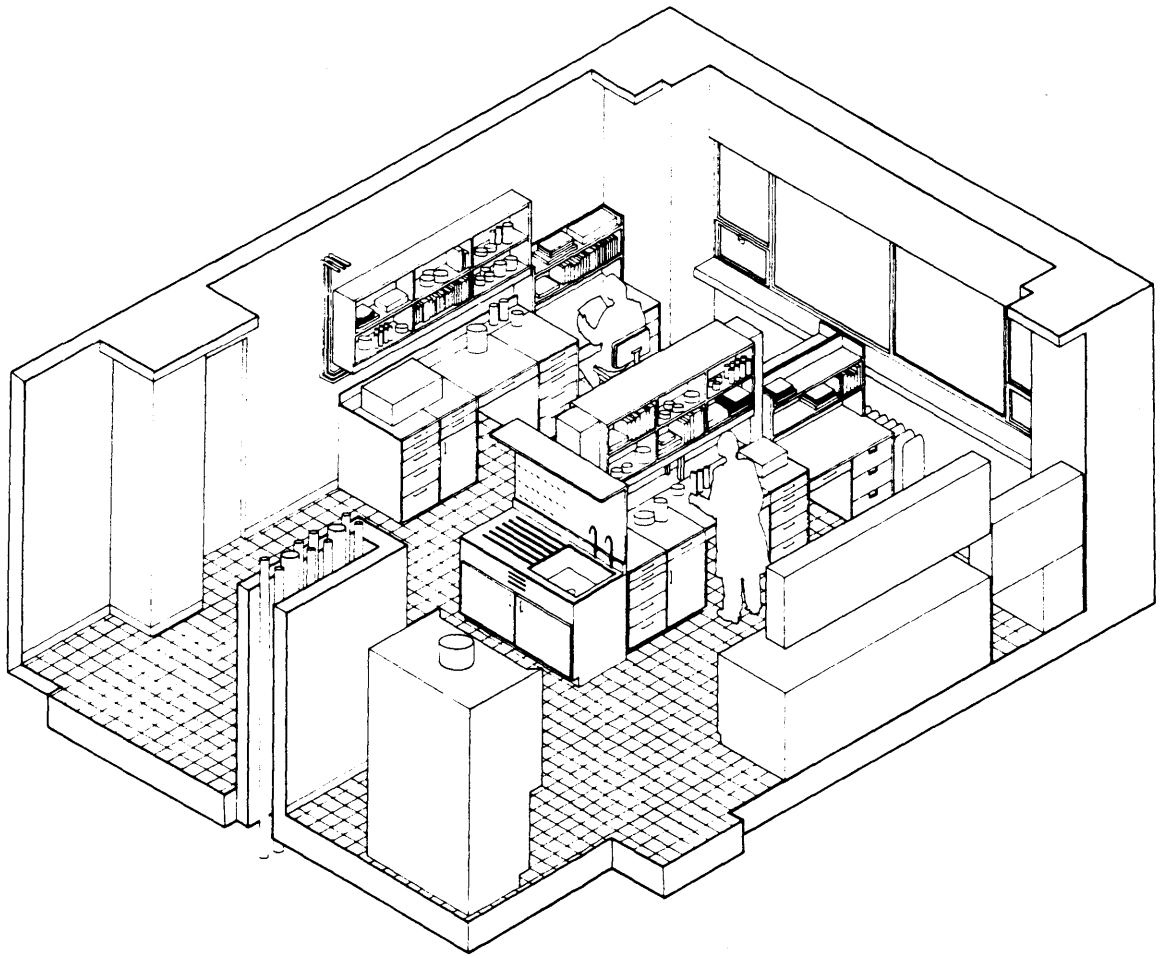


Generic laboratory elevation



Source: The Children's Hospital Facilities Planning Office Research Expansion Update, June 1987

FIGURE 2



Source: Ellenzweig, Moore and Associates, Inc.
Brochure for Tupper Research Institute 1987

researchers. The corridors become extensions of the workspaces and allow for informal contact between members of different research groups[2].

The evolution in lab design is depicted in Figure 3, the plan for the Enders Research Building at Children's Hospital in Boston. The original building, completed in 1970, is at the left of the plan, and has closed lab modules and limited support facilities and offices. The expansion of the Enders Building, to be completed in 1990, shows the open lab concept, as well as the extensive support space demanded by today's research activities. Massachusetts General Hospital employed the open plan in the Wellman Building, completed in 1984, and in the Charlestown Labs under construction as of this writing. Floor plans for these two buildings are shown at the same scale in Figure 4, dramatizing the huge size (180' x 440') of the Charlestown floor plate. Figure 5 shows a typical floor at the Tupper Research Institute at New England Medical Center in Boston. Once again, open labs line much of the building perimeter, here on a very small (7500 square feet) floor plate.

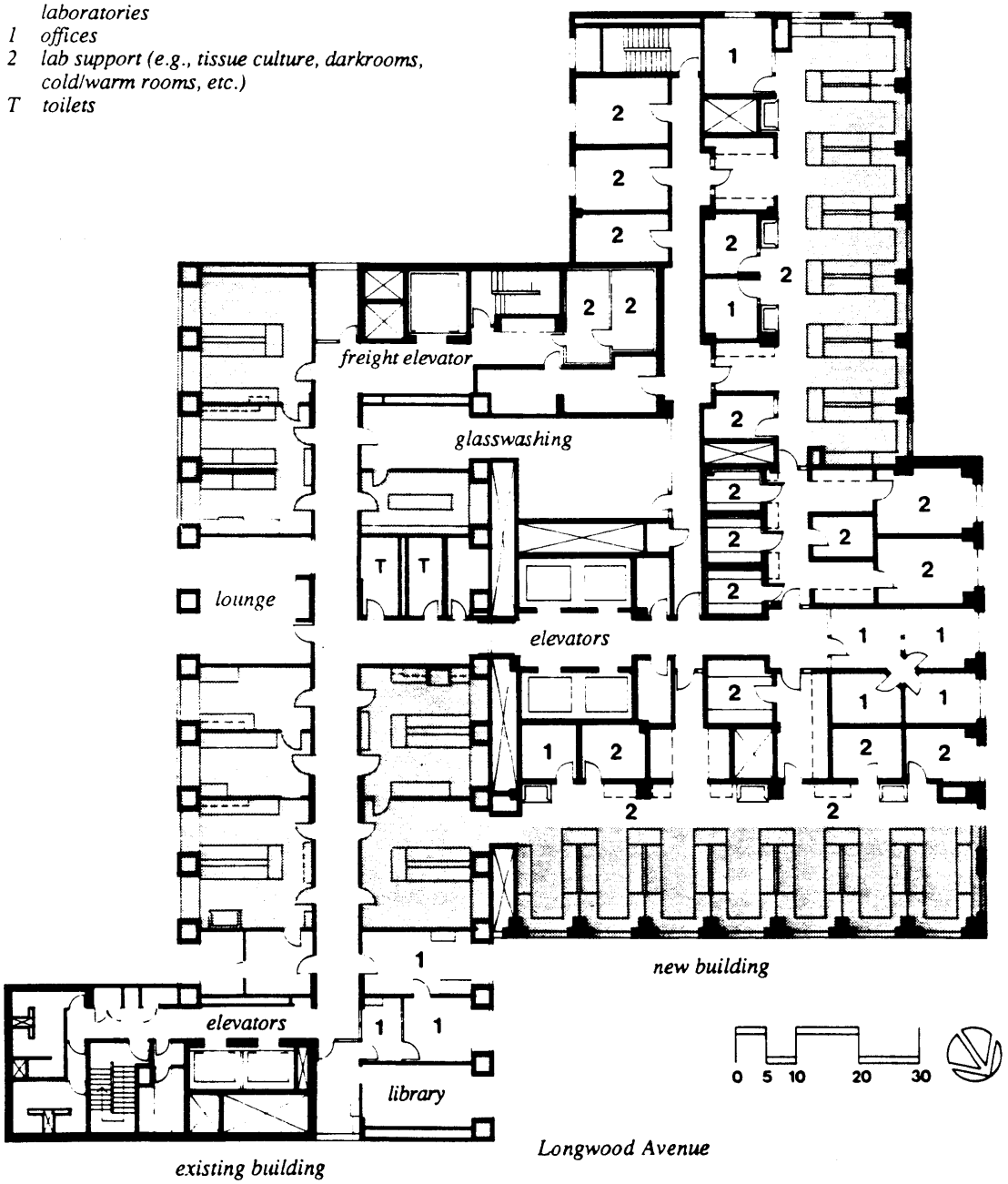
The single most important distinction between lab space and other building typologies is the quantity of mechanical services provided. The engineering is especially challenging when a building is being retrofitted from a different use. One architect estimated that 70% of the design work in a retrofit project is in the engineering. He even suggested that it might be appropriate to designate the

FIGURE 3

Generic laboratory floor plan

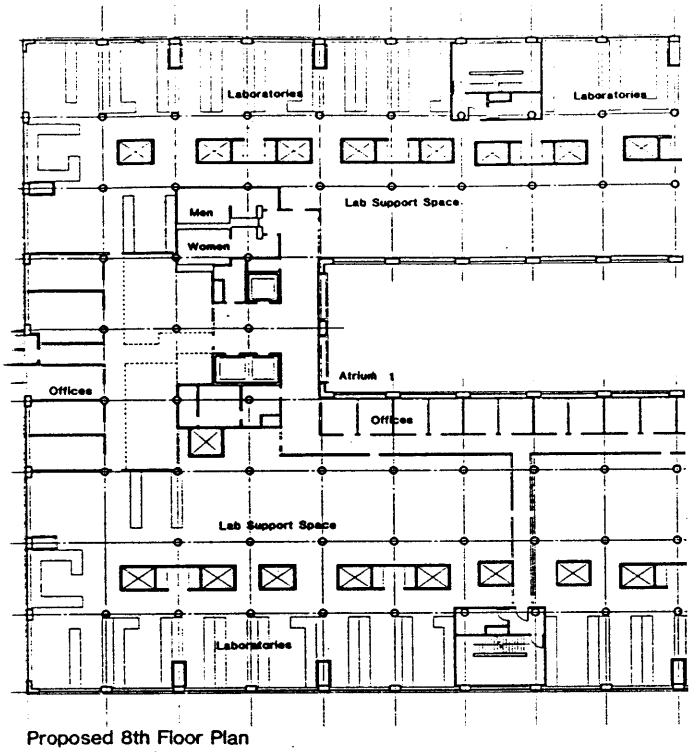
Key

laboratories
1 offices
2 lab support (e.g., tissue culture, darkrooms, cold/warm rooms, etc.)
T toilets



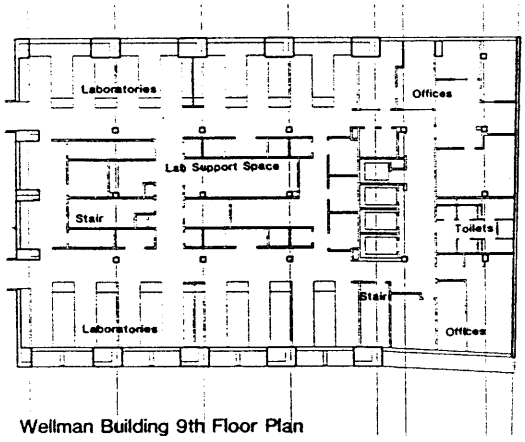
Source: The Children's Hospital Facilities Planning Office
Research Expansion Update, June 1987

FI(



Proposed 8th Floor Plan
Jung/Brannen Associates, Inc., Architects & Planners
September 29, 1986 Job No. 86040

Charlestown Labs



Wellman Building 9th Floor Plan

Source: Jung/Brann
Architects

FIGURE 5

Typical floor plan

1 *Service corridor/shared equipment*
2 *Tissue culture laboratory*
3 *Radioisotope laboratory*
4 *3-person laboratory*
5 *Warm room*
6 *Cold room*
7 *Darkroom*
8 *4-person laboratory*
9 *Offices*

Equipment and support zone

Laboratory zone

Offices

Source: Ellenzweig, Moore and Associates Inc., Architects Brochure for Tupper Research Institute, 1987

mechanical engineering firm as the lead design consultant, with the architect in the subcontractor position.

Because of the many mandatory functional and safety criteria governing lab design, there are few opportunities for cost cutting. Compromises in the quality of environmental systems may lower the cost of construction, but will add to life cycle costs and could jeopardize the safety of the occupants and the facility's neighbors[3].

Some of the special design components include: an elaborate air-handling system to exhaust fumes or maintain positive or negative air pressures (when fume hoods are in operation, labs can require 15-25 air changes per hour; a typical office use demands 1-2 air changes per hour); heavy electrical including emergency power generators for refrigeration equipment; neutralization or sterilization systems for laboratory waste liquids; dry sprinkler systems for cold rooms or freezers; explosion- or radiation-proof rooms; vibration-isolated facilities for electron microscopes; and facilities for washing and sterilizing lab glassware[4].

One of the most expensive and stringently regulated components of a medical research facility is the Animal Room. Laboratory animals require tightly controlled atmospheric conditions, filtered air exhaust, and special water and drainage systems.

Additionally, each lab bench is typically serviced by hot and cold tap water, distilled water, natural gas,

compressed air, and sometimes vacuum air systems. Lab support facilities include warm rooms, cold rooms, dark rooms, and computer rooms.

Office space for the principal investigators and departmental support staff is provided on each floor, adjacent to the labs themselves. The quality and quantity of this space will depend on institutional priorities.

Developers who intend to produce medical research space must recognize the complexity of the facility. The selection of professionals with laboratory design experience is a must. Extra design time must be built into the development process to assure that regulatory, safety, and operational issues are adequately addressed.

NOTES

1. Braybrooke, Susan, ed.
   Design for Research--Principles of Laboratory Architecture, Preface
   John Wiley & Sons, New York 1986

2. Ellenzweig, Moore and Associates, Inc., Architects
   Brochure for Earl S. Tupper Research Institute, 1986

3. Braybrooke, op. cit., Chapter 3

4. Braybrooke, op. cit., Chapter 4

Chapter X

NATIONAL ACTIVITY

Across the country, the development of new medical research space continues to be performed by the institutions who will occupy the facilities. Universities and hospitals are actively producing or planning new space in order to be more competitive for research funding. There are indications that locational constraints and/or financial conditions may cause institutions to seek the services of the private development community to help with their future expansion.

Modern Healthcare magazine's 1987 poll of architects and construction firms tallied 41 completions and 42 starts of medical research facilities in 1986. Briefly mentioned in the accompanying article were research parks planned by Johns Hopkins Hospital and the Mayo Clinic[1]. Hospitals magazine ran an article at the same time indicating that the medical R & D industry is "going bonkers from coast to coast"[2]. Buildings planned or underway include a 300,000 square foot facility for Johns Hopkins University in Baltimore, the Institute for Advanced Biomedical Research at Oregon Health Sciences University in Portland, and the Human Biology Research Facility at the University of Iowa in Iowa City.

A number of urban medical centers contacted for this paper indicated that research space was at a premium. A common solution was to relocate administrative functions

away from the medical center and convert the vacated office space into labs. Columbia/ Presbyterian Medical Center in New York has considered some lease opportunities but will probably purchase a building off-campus. New York Hospital/Cornell Medical Center has expanded by densifying its campus. The old-style pavilions and courtyards are being filled in to increase the floor area.

In Philadelphia, Children's Hospital and the University of Pennsylvania Medical School have each leased research space on occasion from the University City Science Center. UCSC is a 20-year-old non-profit R & D park owned by several area educational institutions. Since it abuts the Penn campus, the park is fairly convenient for Medical School researchers. Rather than taking additional leased space, however, the hospital will devote two floors of its new ambulatory care facility to research space, while Penn is constructing a major laboratory building on campus.

Other institutions, like U.C.L.A. Medical Center, are able to occupy adjacent underutilized public buildings (in this case, a former Army hospital owned by the county). Because administrators there saw little chance of assistance from the state legislature, U.C.L.A. hopes to fund a new $50 million medical research building with contributions. A gift campaign is underway. The University of California at San Francisco Medical Center is in a more difficult situation. The institution continues to honor a decade-old commitment to the surrounding neighborhood not to increase

the density of its campus. Several hundred thousand square feet of administrative space has been moved to off-campus locations and replaced with research facilities. At this writing, the Medical Center, which is the second largest NIH grantee in the nation, is litigating its right to convert a 300,000 square foot office building to research space. U.C.S.F.M.C. has purchased the building, which is one mile from campus, but has been blocked from moving forward by community groups. Robert Ryan of the Office of Resource Management at U.C.S.F. said that leasing research facilities could well be an attractive alternative.

At least one national developer has announced its intention to develop build-to-suit facilities for lease to academic medical centers. According to Judy Glos, managing partner of Tishman-Speyer/Mediq, research buildings are just one of several types of specialty facilities the firm will offer to construct and own for medical centers.

Tishman-Speyer/Mediq was formed in 1987 by Tishman-Speyer, a long-standing New York-based builder, developer, and manager of Class A office buildings, and Mediq, Incorporated, a New Jersey-based multi-line provider of services to hospitals. The firm is confident that it can save medical centers a great deal of time and money in the development of research facilities. Ms. Glos cites Tishman-Speyer's excellent track record in bringing major development projects in on-time and under-budget, and Mediq's expertise in medical building design. The major

obstacle the firm has faced thus far, she added, is a lack of understanding of how to proceed on the part of medical center administrators. Because the concept of leasing major facilities has not been tested in the health care industry, she acknowledges that her challenge is to educate administrators about the advantages of leasing.

At the University of Maryland Medical School, planning is underway for a 415,000 square foot research facility which will likely cost in excess of $100 million. Vice Dean Dr. Marjorie Wilson favors engaging a national developer like Tishman-Speyer/Mediq to build the facility and lease it back to the School for at least 20 years. She estimates that several years and up to $35 million could be saved by circumventing the extremely lengthy state capital budgeting process.

For a facility of the type that University of Maryland wishes to build, a long-term lease contract could be structured similar to turn-key contracts for headquarters office buildings or industrial plants. The lease rate would be set upon completion of schematics, allowing for an extensive level of user input into the design. For the base lease amount, which in effect is a guaranteed maximum price contract, the institution is provided with "finished shell" space. All systems, utilities, floor, wall, and ceiling coverings, and lighting would be in place, awaiting only the movable lab equipment and the more specialized instruments. The length of the lease would be partially decided by

regulations governing operating leases vs. capital (or financing) leases.

In some parts of the country, communities are attempting to leverage economic development off of a medical research infrastructure. Nature magazine described the efforts of Montgomery County, Maryland, to attract biotechnology companies by taking advantage of existing research activities in the area. With the University of Maryland, the NIH, and several other federal research agencies already in place, the county hopes to compete with the San Francisco Bay area and the Boston area[3].

Montgomery County's prototype might be the Massachusetts Biotechnology Research Park, located in Worcester. Adjacent to the University of Massachusetts Medical Center, the park sits on 75 acres and is programmed for over a million square feet of space. MBRP is owned by a non-profit economic development corporation supported by the City of Worcester. Director Ray Quinlan said the park is not intended to satisfy the space needs of the Medical Center. Rather, it is targeted towards the growing biotech firms that are seeking low-cost space with immediate access to a thriving academic community. Quinlan can offer research space at half the cost of Boston space because of the low-rise, non-union construction, subsidized land (it was surplus to a state hospital), and low taxes. At this writing, the first 75,000 square-foot research building is nearly fully occupied the second is under construction.

Locational constraints on expansion are particularly prevalent among many older institutions in dense urban areas. Such institutions are found in abundance in Boston. Their solutions to the expansion problem is illustrative for developers seeking to service a need for research space production. The case studies in the following chapter will examine those solutions.

NOTES

1. "Construction/Architects Survey"
   Modern Healthcare, February 27, 1987

2. Cherskov, Myk
   "Research and development facilities attract money"
   Hospitals, February 20, 1987, p. 62

3. "Research centre gets fixed home"
   Nature, Vol. 324, p. 400, December 4, 1986

Chapter XI

CASE STUDIES IN THE BOSTON MARKET

The cities of Boston and Cambridge form one of the premier centers in the world for medical care, medical education, and medical research. Many of the region's hospitals are internationally acclaimed. Table 2 lists Boston's major teaching hospitals and gives a sense of their impact on the regional economy. Harvard, Tufts, and Boston University house their medical schools in the city. The NIH awarded more than 10% of its 1985 research grants to Boston-based universities, hospitals, and research institutes. Table 3 ranks the city's institutions by NIH grant volume. As shown in Table 4, the state of Massachusetts ranks third in the country in total NIH awards. When viewed locally, metropolitan Boston has the second-highest concentration of health R & D funding in the country, after New York City. The region also is home to over two dozen firms specializing in biotechnology, including several of the leaders of this nascent industry.

Throughout the 1980s, the region has also been one of the strongest markets in the country for both commercial and residential real estate. This boom, when coupled with the anti-growth activities of tenant-advocacy groups and a prediliction towards downzoning on the part of city development agencies, has constrained the ability of some institutions to expand on their urban campuses. The following cases describe how several of the city's

institutions have dealt with the need to expand their research capacity in the face of this difficult real estate market.

TABLE 2

BOSTON'S TEACHING HOSPITALS

RANKED BY 1985 TOTAL EXPENSES

	HOSPITAL SERVICE	OWNERSHIP	PATIENT BEDS	EXPENSES (millions)	EMPLOYEES (FTEs)
1.	Massachusetts General Hospital Gen'l Medical	Private Non-Profit	1082	$ 296.8	6085
2.	Brigham & Womens Hospital Gen'l Medical	Private Non-Profit	720	241.0	4760
3.	Childrens Hospital Medical Center Pediatric	Private Non-Profit	339	166.9	3277
4.	New England Medical Center Gen'l Medical	Private Non-Profit	416	155.3	2457
5.	Beth Israel Hospital Gen'l Medical	Private Non-Profit	449	154.9	3481
6.	New England Deaconess Hospital Gen'l Medical	Private Non-Profit	489	120.1	2433
7.	University Hospital Gen'l Medical	Private Non-Profit	379	88.7	1455
8.	St. Elizabeth's Hospital Gen'l Medical	Church-Operated	385	87.0	1847
9.	Veterans Administration Medical Center Gen'l Medical	VA-Operated	691	79.2	1650
10.	Carney Hospital Gen'l Medical	Church-Operated	422	66.9	1541
11.	Mt. Auburn Hospital (Cambridge) Gen'l Medical	Private Non-Profit	305	62.5	1311
12.	Massachusetts Eye & Ear Infirmary Specialty	Private Non-Profit	174	60.1	1029
13.	Dana-Farber Cancer Institute Specialty	Private Non-Profit	57	59.2	1077
14.	Faulkner Hospital Gen'l Medical	Private Non-Profit	259	44.6	939
15.	New England Baptist Hospital Gen'l Medical	Private Non-Profit	245	44.6	965
	Boston City Hospital Gen'l Medical	City-Operated	393	N/A	N/A
	TOTALS #1 - 15		6,412	$1,727.8	34,307

Source: American Hospital Association
AHA Guide to the Healthcare Field 1986
Thomas J. Andrews 1987

TABLE 3

BOSTON AREA RESEARCH INSTITUTIONS

1985 RESEARCH GRANTS FROM NATIONAL INSTITUTES OF HEALTH

1.	Harvard Medical School	$ 56,700,000
2.	Massachusetts Institute of Technology	42,300,000
3.	Brigham & Womens Hospital	33,800,000
4.	Boston University School of Medicine	31,900,000
5.	Massachusetts General Hospital	29,200,000
6.	Dana-Farber Cancer Institute	25,300,000
7.	Childrens Hospital	18,800,000
8.	Tufts University School of Medicine	17,900,000
9.	Harvard University	12,900,000
10.	Beth Israel Hospital	9,600,000
11.	New England Medical Center	8,800,000
12.	Eye Research Institute--Retina Foundation	5,300,000
13.	Whitehead Institute for Biomedical Research	5,100,000
14.	Massachusetts Eye & Ear Infirmary	4,900,000
15.	Forsyth Dental Center	4,800,000
16.	Center for Blood Research	3,500,000
17.	Joslin Diabetes Clinic	3,500,000
18.	Boston City Hospital	3,100,000
19.	New England Deaconess Hospital	2,700,000
20.	University Hospital	2,700,000
	TOTAL	$ 322,800,000

NOTE: These figures include research grants only. Training grants, contracts, and fellowships are not included.

SOURCE: National Institutes of Health
Research Grant Directory 1985
Thomas J. Andrews 1987

TABLE 4

NIH RESEARCH GRANTS--FISCAL 1985

EXTRAMURAL GRANTS RANKED BY STATE

Rank	State	$ in millions	Rank	State	$ in millions
1.	California	519.1	11.	Ohio	93.6
2.	New York	504.5	12.	Minnesota	87.1
3.	Massachusetts	382.6	13.	Michigan	85.9
4.	Pennsylvania	214.2	14.	Missouri	77.2
5.	Texas	173.8	15.	Wisconsin	69.6
6.	Illinois	128.2	16.	Tennessee	62.1
7.	Maryland	117.4	17.	Florida	50.3
8.	North Carolina	108.9	18.	Virginia	50.0
9.	Washington	101.3	19.	Colorado	49.3
10.	Connecticut	100.0	20.	Alabama	48.0

All Other States 444.0

Total NIH Extramural R & D Expenditures $ 3,466,800,000

NOTE: These figures include research grants only. Training grants, contracts, and fellowships are not included.

SOURCE: National Institutes of Health
Research Grants Directory 1985
Thomas J. Andrews 1987

BETH ISRAEL HOSPITAL

Beth Israel Hospital is a 449-bed not-for-profit general hospital located on Brookline Avenue in Boston's Longwood Medical Area. A teaching affiliate of the Harvard Medical School, Beth Israel received nearly $10 million in NIH research grants in 1985, fifth-highest among Boston hospitals. Its investigators operated out of a cramped 50,000 square-foot facility until 1982, when the hospital doubled its research space with a new building. The additional space became fully occupied within a relatively short time.

At this writing the hospital is constructing a 30,000 square-foot research facility in a two-story building that abuts the BIH campus. The building's owner, Emmanuel College, has signed a ten-year lease with the hospital. Beth Israel has hired a contractor to build out the improvements, which will be funded internally. At the same time, the hospital has plans to construct an additional 30,000 square feet of research space in four stories atop an existing hospital building. Dubbed "Research West", that space is expected to come on line in 1990, and will give BIH a total of 160,000 gross square feet of building area devoted to biomedical research. The hospital expects to issue $10-12 million in debt to help fund the new facility, and has already applied to HHS for a deviation from the interest reimbursement exclusion.

The hospital's administration is confident that they

will not have to expand off-campus in the foreseeable future. The Director of Research, Joan Pinck, expressed two major concerns about moving research away from the main campus. First is the fact that many of the researchers also have patient care and teaching responsibilities at the hospital, and they do not wish to spend time travelling to and from remote facilities. Secondly, there are costs and inefficiencies associated with off-site research space because certain ancillary services and facilities (for example, animal storage) would have to be duplicated at each site, and transportation would have to be provided for both employees and research supplies (like tissue samples, etc.). Ms. Pinck noted that utilization of the abutting Emmanuel College campus is a possible solution for future space needs. Emmanuel College has suffered declining enrollments in recent years.

BRIGHAM & WOMENS HOSPITAL

Brigham & Womens Hospital, with 720 beds, became the the second-largest hospital in the city when it was formed in 1980 through the merger of three adjacent institutions. BWH is a not-for-profit teaching affiliate of the Harvard Medical School. Situated on Francis Street at the southern end of the Longwood Medical Area, it encroaches more closely on the abutting Mission Hill neighborhood than the other institutions in the area. With a 1987 research budget of some $50 million, 80% of which is funded by the National

Institutes for Health, BWH is the number one NIH grantee among hospitals in the country. All of the hospital's research space is housed on its Francis Street campus.

In 1985, the sixteen-story, 180,000 square foot George W. Thorn Research Tower was completed, under a novel arrangement between three institutions: the Brigham & Womens, which occupies nine and a half floors, Harvard Medical School, which occupies four floors, and the Howard Hughes Medical Institute, which occupies the remaining two and a half floors. Each floor of the $28 million tower is a condominium unit. The condominium owners rent the ground on a 40-year lease from the hospital.

Harvard and the Hughes Institute paid for their six and a half units with cash from their endowments. The hospital did not have that option because of covenants related to debt issued for the earlier construction of a new inpatient building. For this reason, and because OMB reimbursement regulations would have precluded recovery of interest costs, additional borrowing was out of the question. The hospital considered issuing tax-shelter limited partnerships, but abandoned that idea when uncertainties about tax reform arose.

The institution finally settled on an unusual lease arrangement. Hospital counsel set up an unaffiliated nonprofit foundation to own the nine and a half condominium units. The directors of BioSciences Research Foundation were recruited from other research institutions in the

community, to satisfy the "arms-length" requirement in the OMB regulations. The Foundation then approached a long-term lender, Aetna Life Insurance, to secure construction and permanent financing on the basis of the hospital's intention to lease the nine and a half floors. Aetna agreed to a thirty-year self-amortizing mortgage. Because their only security was a portion of a limited use building and the hospital's promise to pay rent on same, the lender demanded an additional return. The borrower was required to take down the full amount of the permanent mortgage at the start of construction. This amount was escrowed, costing the hospital more than $1 million in negative arbitrage during the construction period. As further protection for the permanent lender, Bank of New England provided a letter of credit to cover construction cost overruns. According to Jim Sweeney of the Bank, it was crucial that the project be completed on time and on budget because the borrower was a shell foundation. A reliable contractor, George B. Macomber & Company, was hired and fully bonded. Bank engineers closely monitored the construction, which proceeded smoothly to completion.

The hospital's lease with the foundation is set up so that rent charged is roughly equal to the mortgage payments. A slight overage from the rental payments is distributed among the research institutions from which the foundation directors are drawn. The hospital is able to recover full reimbursement from NIH for its lease payments, and generates

a nominal incremental cash flow through the ground lease.

Additional research space for BWH investigators is being built as needed in the old Boston Lying-In Hospital on Longwood Avenue, which was acquired as part of the 1980 merger. Renovation costing $150/square foot is in process for some 40,000 square feet, with an additional 30,000 square feet likely to follow. These renovations are being funded out of hospital capital reserves. The hospital intends to seek approval from the Boston Redevelopment Authority in 1988 for a 180,000 to 200,000 square foot research facility on the site of an obsolete building on campus. If this growth occurs as planned, the hospital could have nearly 350,000 gross square feet of building area dedicated to biomedical research by 1992.

While acknowledging that a significant portion of the research done on the Francis Street campus could actually be done off-site, Vice President for Administrative Services John Cupples stated that it was "highly preferable" to maintain all research facilities on the hospital grounds. He spoke very favorably of the three-party ownership arrangement, indicating that a great deal of "cross-pollenization" occurs when investigators from different institutions can talk to each other in the corridors or over lunch. Additionally, some economies of scale are realized through the sharing of storage and other support areas by the three partners. Cupples noted another benefit of the condominium building: if the Hospital has a

short-term surplus of lab space due to a grant expiration, the Medical School could lease the space, or vice versa.

Like his colleagues at other Boston teaching hospitals, BWH's Vice President was confident that research volume would continue to grow in the future. He foresaw the premier research hospitals, such as BWH, getting a bigger piece of the NIH pie, as well as expanding into potentially profitable research partnerships with academia and the commercial biotechnology industry.

CHILDREN'S HOSPITAL

Children's Hospital, located on 8 acres off Longwood Avenue in the heart of the Longwood Medical Area, is one of the premier institutions in the world specializing in pediatric inpatient care. The 339-bed Harvard teaching hospital is in the midst of a major upgrading, with an entirely new inpatient building under construction. Also on campus is the 178,000 square foot Enders Research Building, which opened in 1970. The Children's was the fourth-largest NIH grantee among hospitals in 1986, with a total research budget of some $27 million. The budget has grown at an average real annual rate of 2.5% over the past decade. To keep up with this growth, the hospital is planning an addition to the Enders building which will roughly double its size. This addition, scheduled to open in early 1990 with construction costs of $200/square foot, is funded internally through the hospital's endowment and through a

major gift campaign. Additional funds for construction were secured in the form of a capital lease prepayment by the Howard Hughes Medical Institute, whose researchers will occupy 30,000 square feet of the completed building.

Because on-campus research space will nearly double when the new facility comes on line in 1990, Children's Hospital does not anticipate moving any research off-campus in the foreseeable future. According to the Long Range Plan for the Hospital's PDA (Planned Development Area), submitted to the Boston Redevelopment Authority in April 1987:

> The three activities which are central to Children's mission -- inpatient care, research, and education -- and intimately linked must remain on the central campus. As other uses are decentralized and research expansion projects are completed, there will be room for internal expansion without requiring major new construction for a number of years.

The Vice President of Children's, Carol Weinrib, surmised that opportunities for private developers to produce research space for hospitals could occur if three conditions existed:

1. The institution in need of space has limited options for its own property because of zoning or F.A.R. constraints.
2. The institution has limited access to capital at the time.
3. The developer is able to create an attractive facility with enough critical mass to keep the researchers from feeling isolated or segregated from the institutional mainstream.

DANA-FARBER CANCER INSTITUTE

The Dana-Farber Cancer Institute, situated on Binney Street in the heart of the Longwood Medical Area, is one of the leading centers in the world for the diagnosis, treatment, and study of cancer. The Institute's researchers received over $25 million in NIH grant monies in 1985, of a total research budget of over $30 million. With the study of cancer as its primary mission, DFCI operates only 57 patient beds. The Institute's commitment to continued leadership in cancer research is embodied in the new Mayer Building, a 9-story, 120,000 square-foot structure now being built at a cost of $24 million. The entire building will be occupied by research labs, adding to the 165,000 existing square feet at the Institute. Director of Research Dr. Bernard Janicki says the new space will alleviate a severe overcrowding condition and allow for recruitment of some new research faculty.

Janicki stated that it was unlikely that DFCI research facilities would ever be built away from the main campus. The Institute's researchers all have clinical and teaching responsibilities in the Longwood Medical Area, and DFCI itself has research and clinical interrelationships with several of the other Longwood Area hospitals. For example, one of New England Deaconess Hospital's cancer treatment facilities is located in a DFCI building, and the Cancer Institute's pediatric oncology department is housed at the Children's Hospital.

NEW ENGLAND DEACONESS HOSPITAL

New England Deaconess Hospital is a 489-bed Harvard teaching hospital located in the Longwood Medical Area. With 56,000 square feet of research space in two on-campus facilities, the Deaconess recently made an institutional commitment to upgrade its teaching and research reputation, a commitment that would require more and better lab space. At the same time, the hospital was facing the need to substantially renovate its aging patient care facilities. The huge capital requirements of the bed replacement forced the hospital to a less capital-intensive solution for its research needs. Furthermore, the physical constraints of the NEDH campus demanded that new research facilities be created off-site.

To solve its research space problem, the hospital entered into an agreement with a local contractor, Kennedy & Rossi Inc., specialists in laboratory construction. K & R leased 20,000 gross square feet of shell space in a warehouse near Kenmore Square that happened to be owned by Children's Hospital. The space was built out to NEDH's specifications by K & R, then subleased to the hospital at a rate which covered all of K & R's construction and carry costs, and profit. All operating expenses are paid by the hospital, as are any expense pass-throughs (such as tax escalations), that K & R has to pay under its lease from Children's. The lease and the sublease each run for ten years, as does the bank financing that K & R arranged for

all the hard and soft costs. Hospital researchers occupied the space in late 1986.

The hospital's Director of Research, Robert Pence, is pleased with the arrangement, although he acknowledges that the rental rate is expensive. But because 70% of NEDH's research dollars come from the federal government, with full reimbursement for operating lease expenditures, most of those costs are being recovered. Even if the land and debt capacity had been available for Pence to build a new research facility on campus, the hospital would have been unable to recover interest payments as part of their indirect cost reimbursement for research grants. Furthermore, OMB reimbursement guidelines require the depreciation allowance to be calculated on a building finish useful life of twenty years, whereas with the lease the construction cost is essentially amortized over the ten-year term, thus allowing significantly higher reimbursements. The hospital also had the benefit of having the facility up and running more quickly than had it petitioned for the interest reimbursement waiver and tried to build the facility itself. Charged with upgrading the institution's research reputation, Pence needed space in a hurry in order to begin attracting qualified people.

As for the facility's location one mile from the hospital's main campus, considerable grumbling from those being transferred had to be endured by the hospital administration, and shuttle transportation had to be

provided for the research staff. However, once routines became established, people began to acknowledge that the inconvenience was only minor. Also, because the remainder of the building was occupied by NEDH ancillary departments such as Accounting and Data Processing, the research labs were not completely isolated from hospital activity. Research Director Pence is sufficiently satisfied with the arrangement to be looking for another lease opportunity, as the Kenmore Square space is now fully occupied. He estimates an additional requirement of 65,000-130,000 square feet over the next 5-10 years.

NEW ENGLAND MEDICAL CENTER HOSPITAL

The New England Medical Center campus is located in the densely residential Chinatown neighborhood near downtown Boston. NEMC Hospital is a 416-bed teaching hospital affiliated with the Tufts University School of Medicine. The NEMC Hospital had a research budget of $25.5 million (70% from the federal government) in 1987, up from $12 million in 1982.

In 1984, the hospital was utilizing 60,000 square feet of extremely cramped lab space. The decision to expand had been made, but little capital was available from the hospital's endowment. The Medical Center fielded offers from developers for the turn-key construction and lease-back of off-site research facilities, but few of the firms had the requisite experience in the development of such

facilities. Funds for expansion suddenly appeared when a grateful, and wealthy, former patient expired and left some $10 million to the hospital. NEMC promptly converted the 14-story, 60-year-old garment factory at 25 Kneeland Street into the Tupper Research Institute. The 100,000 square foot facility, which the hospital had purchased earlier because of its strategic location on the edge of campus, was renovated at a cost of $165 per gross square foot.

The Tupper gift came just at the right time for the hospital. Although Director of Research Administration Frank Stout says, "We really don't want to work with anyone we don't have to (ie., outside developers)", he acknowledged that NEMC might have had to solve its space squeeze by leasing turn-key space from a developer. With researchers now moved into the newly renovated facility, the hospital is renovating the older laboratories in the Ziskind Building to bring all its facilities up-to-date. Funding is being generated through a four-year $24 million gift campaign.

To assure that the costs of medical research are covered adequately by the reimbursement dollars received, NEMC uses stringent internal productivity standards for lab space allocation. Each research department must generate $200 of direct cost reimbursement per net square foot of lab space utilized. Thus, if the Neurology department occupies 10,000 net square feet of labs, it must generate at least $2 million in direct reimbursement or it may be required to relinquish lab space to another, more productive department.

TUFTS UNIVERSITY SCHOOL OF MEDICINE,
SCHOOL OF DENTAL MEDICINE,
SCHOOL OF GRADUATE BIOMEDICAL SCIENCES

Tufts' health sciences divisions are housed in several buildings abutting the NEMC campus in Chinatown. The university's 1986 research budget was about $38 million, some $12 million of which was directed to the US Department of Agriculture's Human Nutrition Research Center, which is operated by Tufts. Of the remaining $26 million, 80% is funded by the federal government. Although budget growth was flat in 1986, research funds had expanded at a rate of over 15% per year for the previous four years. This growth has saturated the 100,000 net square feet of existing laboratory space which is scattered throughout the complex of renovated older buildings at 136 Harrison Avenue.

Dr. Joseph Byrne, Associate Provost for Research, described plans for an additional 70,000 net square feet of research space by 1992. A large chunk of this would be housed in the so-called "Infill Building" that would fill in the horseshoe-shaped complex at 136 Harrison. Dr. Byrne said the School's long-range plans call for a total of 250,000 net square feet dedicated to research by 1997.

The University has kicked off a five-year capital campaign to help finance the planned expansions. Dr. Byrne anticipates that the Infill Building would be funded one-third by borrowing and one-third by donations, and that the remaining capital could be secured from the federal

government in the form of a direct construction grant. Although the NIH has issued very few capital grants recently, Tufts' adminstration is confident that funds will soon come available and that the School of Medicine will be able to access those funds.

When asked if leased facilities were a viable alternative for the School, Dr. Byrne responded that the option would certainly be considered if sites could be found within walking distance to the main campus. Investigators, he noted, usually have teaching responsibilities at the School and clinical responsibilities next door at NEMC. They would be very reluctant to venture too far off-site to reach their laboratories.

BOSTON UNIVERSITY SCHOOL OF MEDICINE

UNIVERSITY HOSPITAL

Boston University Schools of Medicine and Graduate Dentistry and University Hospital share a campus on the fringe of the city's South End neighborhood. The Schools and University Hospital had 1985 research grants of nearly $35 million from NIH, most of that assigned to the School of Medicine. This figure represents some 80% of the total research budget for the institutions. University Hospital, a 379-bed teaching facility which is affiliated with but not owned by the School, is nearing completion of a $66 million reconstruction of its patient care buildings. The School of Medicine has about 180,000 square feet of research space

scattered throughout its campus.

BUSM has leased research space in the past from the state's Department of Mental Health, which operates a building next door to the School of Medicine. This favorable experience led the school's Dean, Dr. John Sandson to choose the lease option when expansion space was needed in 1987. The School has entered into an agreement with Community Development Corporation of Boston, a non-profit developer, to lease 37,000 square feet of shell space on the top three floors of 801 Albany Street, a five-story building located a few blocks from the main campus. The 60-year-old former paint brush factory had been sold below cost to CDC of Boston. Since the structure is in an economically disadvantaged neighborhood, a package of federal, state, and city loans and guarantees will supplement the bank loan for the improvements. The five-year lease has three five-year options, and calls for the School to build out the improvements. As an educational institution, not a hospital, BUSM can recoup its interest costs from the federal government should it choose to borrow money to construct the laboratory space.

Dean Sandson estimates that the School of Medicine will require another 50,000 square feet of research space within the next five years. Because the existing campus will not support any further development, it seems likely that the school will be looking for space around the perimeter of its property in the South End.

MASSACHUSETTS GENERAL HOSPITAL

Massachusetts General Hospital, with 1082 beds, is the largest hospital in New England, both in terms of total budget (nearly $400 million in 1987) and in research expenditures ($75 million). The institution, which is affiliated with the Harvard Medical School, occupies a densely built campus in the West End of Boston, facing the Charles River. MGH broke ground in 1987 for the first of two new, and long-delayed, patient care towers costing $250 million. The Hospital devotes nearly 290,000 square feet on campus to biomedical research, and early in 1987 reinforced that commitment by signing a substantial long-term lease in Building 149 at the former Charlestown Navy Yard.

Of the $75 million budgeted for research, 55% is from the federal government, 17% from foundations, 10% from the endowment, and 18% from commercial contracts. The percentage of commercial funding has increased dramatically in recent years as research breakthroughs at the hospitals began to show market promise. The Hospital aggressively requires all its funding sources to reimburse the institution for indirect costs at the overhead rate established by OMB. Any exeptions to this policy have to be reviewed by the Hospital Board of Directors. The policy attempts to ensure that research operations are not subsidized by patient care revenues, a situation that would be unacceptable to third party payors and which conflicts with the institution's primary mission as a care provider.

The Charlestown Navy Yard, closed by the Nixon Administration in 1974 and turned over to the Boston Redevelopment Authority (BRA), is being redeveloped into housing, offices, and other uses by private developers designated by the BRA. Building 149, a ten-story, 650,000 square foot former warehouse, had been renovated into speculative office space by the Congress Group, a private developer. When many months passed with no office leases consummated, the Congress Group sold its interests in Building 149 and its neighbor, Building 199 (which had been made into a 1400-car garage), to a group headed by Neil St. John Raymond, an established Boston developer.

Raymond planned to create an enormous medical research center at Building 149. Before closing on the sale of the two buildings, Raymond secured a lease commitment from MGH. If all options are exercised, it will be the most valuable lease ever executed in the city of Boston. Raymond says that his group, which has considerable equity in the project, is essentially acting as a lender to the institution. He felt that the hospital could have purchased Building 149 had it chosen to, but that by selecting the lease option MGH was practicing prudent "fiscal conservatism".

According to Lawrence Martin, Assistant General Director of the Hospital, the lease solved three separate problems for MGH. First, the institution's computer operations were in two different locations on campus and

needed to be consolidated. The same was true of the offices of the fiscal affairs department. Some 92,000 square feet at Building 149 was reserved for these two departments. Third, MGH's researchers were crammed into an average of about 200 square feet of research space per person. The Wellman Research Building, which opened in 1984, had filled up quickly, and now some investigators were applying for continuations from their sponsors because no lab space was available in which to start their experiments.

The lease between MGH and Biotechnology Research Associates, Inc., is for 175,000 square feet (92,000 square feet office and computer, to be occupied in September 1987; and 83,000 square feet research, occupancy January 1988). An option, to be exercised by March 1988, provides for an additional 205,000 square feet of research space. At this writing, Assistant Director Martin reports that the initial research space, plus three quarters of the option space, has been subscribed to researchers who are already funded. The Hospital fully expects to "sell out" the rest of the space and exercise the option. This enormous space consumption is somewhat illusory in that researchers at Building 149 are initially being allocated some 500 square feet per person. As new researchers are added, however, Martin expects the density to settle around a comfortable and efficient 350 square feet per person.

The term of the lease is 15 years with 5 year renewals, except for the office/computer component, which runs for 10

years. The rental rate bumps up during the term, and the Hospital pays for electricity and for escalations over a base property tax amount. Because the base rental rate is fixed and incorporates a "standard" level of lab finish, the hospital administration has set aside a fund to pay for customized lab spaces. The administration allocates this money based on institutional research priorities.

Since the Navy Yard is over a mile from the Hospital campus, many in the medical research community were very surprised to hear of MGH's major commitment in Charlestown. Medical research had always been carried out in the heart of hospital campuses. Even some MGH administrators predicted extreme difficulty in persuading researchers to relocate to a remote facility, away from their patient care and teaching duties. Once the spaciousness and the quality of the new facility were apparent, however, a few key investigators agreed to make the move to Charlestown. These respected individuals provided the critical mass and were followed by many others who wished to maintain proximity to the most prestigious research activities.

The competitive advantage for MGH of having extra research space available was detailed in an article in the June 1987 Boston Hospital News. Describing a program headed by Dr. Kurt Isselbacher, Director of the new MGH Cancer Research Center, which will be housed in Charlestown, the article stated:

> One of Dr. Isselbacher's major tasks will be to recruit additional top-flight scientific talent for the center. He anticipates an almost 30 percent increase in personnel, now that the availability of space in Charlestown has made expansion possible. Many of the new researchers are expected to be young scientists who already have excellent records of accomplishment and who can "come on-board" as quickly as laboratory space is set aside for them. "The whole excitement is to create an even better intellectual scientific environment, which in turn will improve patient care," Dr. Isselbacher said.

Several factors conspired to make the Navy Yard lease an appropriate solution to MGH's space requirements. First, $250 million in tax-exempt bonds had been issued by the Hospital to fund the new patient care towers. Hospital auditors predicted that the issuance of more debt would jeopardize the institution's Standard & Poor's AA rating. Thus, buying or constructing a research building was ruled out as an option. This stance was fortified by the Hospital's experience with the Wellman Research Building. Built with tax-exempt bonds, Wellman drained MGH coffers for a year when HHS enforced the OMB provision against interest cost reimbursement and an expected gift fell through. After protracted negotiations, HHS finally agreed to reimburse for interest expense, and even agreed to pay double interest expense for the second year of operation. Nonetheless, an operating lease arrangement would obviate the need for a waiver application and lengthy negotiations with the federal government. Another important factor in MGH's decision was the opportunity for future expansion at the Navy Yard. Should Building 149 fill up, Developer Raymond promised to

convert part of the huge garage, Building 199, to research space, and beyond that were 14 vacant acres still under BRA control.

MASSACHUSETTS EYE & EAR INFIRMARY

Massachusetts Eye & Ear Infirmary is a 174-bed Harvard teaching hospital specializing in eye, ear, nose, and throat (EENT) care. The Infirmary received 90% of its $6.5 million 1986 research budget from the NIH. Most of MEEI's physical plant, including about 40,000 square feet of research space, is contained in a twelve-story building squeezed between the Suffolk County Jail and the Massachusetts General Hospital campus. The Infirmary was outbid by MGH in its attempt to secure the Jail site, which is to be vacated by the County by 1990. Because of the nearby Beacon Hill and Charles River Park neighborhoods, expansion options are extremely limited for the institution. As of this writing, negotiations are underway for a lease arrangement whereby MEEI researchers would occupy a portion of Building 149 at the Navy Yard in Charlestown.

Vice President of Finance Patrick Capobianco explained the interest in the Charlestown building:

> The growth of our research volume has been constrained for several years by space limitations. Our investigators are clamoring for more space so they can apply for more grant money. With NIH awarding about $200 million per year in EENT research grants, we feel certain that this institution can secure a bigger share of that pie.

The Infirmary is seeking an initial 15-year lease of 40,000 square feet at Building 149, with options to roughly double that amount after three years, and additional options at subsequent intervals. Capobianco expects that a diffusion of existing research will fill most of the initial space. Meanwhile, investigators can begin to prepare proposals for future research grants knowing that the additional laboratories will be available in Year 3. Capobianco noted that the time required for proposal preparation, submission, and award notification can often take around two years.

MEEI will attempt to have as much of the cost of laboratory construction rolled into the lease payment as possible, since the institution will be fully reimbursed for the amount of the lease payment by NIH. Any construction costs that the developer does not roll into the lease payment would have to be picked up by the Infirmary, possibly through borrowing, in which case the interest expense would not be reimbursable without a deviation procedure.

MEEI administrators were initially concerned about the distance from the Infirmary to Charlestown, but are comforted by MGH's success in assembling a critical mass of research activity at Building 149. The Infirmary now does not expect any difficulty in persuading investigators to relocate to the planned new facility in Charlestown.

CASE STUDY SUMMARY

The Boston cases demonstrate that opportunity exists for developers to service the research space needs of teaching hospitals and medical schools. Three institutions have entered into agreements for leased laboratory space, and a fourth is pending. The presence of one or more of the following conditions has steered the institutions to the lease decision. First, the institution is in a competitive environment. Though some institutions fare better than others, it is very difficult to make money on research. A high-quality, expanding research program serves to attract capable clinicians and enhance the institution's reputation, which then attracts patients. Second, the institution's existing campus has no expansion capacity, or the capacity available is reserved for future patient care facilities. Most academic medical centers exist on constrained urban campuses. Finally, there are financial incentives for leasing. The hospital may be funding a major capital expansion, and adding new debt would be imprudent or impossible. The following chapter will demonstrate that federal reimbursement policies favor leasing turnkey space over shell space.

A developer who is attempting to build space to suit a hospital's needs must be cognizant of the delicate position occupied by the hospital administration. A hospital's reputation is created in large part by the doctors who treat its patients. The hospital administration's challenge is to

retain these key people by servicing their needs while still operating the institution as a business. When a hospital develops its own new research facilities, schedule is often a smaller issue than budget. The administration will move methodically to collect the input of the investigators, many of whom will have very specific request for customization of their research spaces. Institutional priorities will then determine whose requests are met within the realities of the budget.

Some design professionals interviewed for this paper suggested that the developer could leverage his position outside the institution to expedite the design process. The lease agreement should stipulate realistic time frames for the collection of user input, with penalty to the tenant if design time overruns because of difficulties in extracting input from the investigators who will occupy the space. If the institution insists on having the design team at its full disposal, the developer must assure that the costs associated with this level of service, including costs of delay in project completion, are borne by the institution.

Chapter XII

FINANCIAL ANALYSIS

Because institutions have traditionally built and owned all of their facilities, a developer proposing a lease arrangement should be prepared to offer some financial justifications to overcome the institution's concerns about lack of control. The proforma cash flow analyses presented in Exhibits 1-4 illustrate the impact of the federal cost reimbursement policies on various occupancy arrangements for research performers. Exhibit 5 looks at a particular arrangement from the developer's cash flow statement.

Except for Exhibit 4, the facts for each case are similar in order to facilitate comparison. Each case assumes that laboratories are built out in shell space rented from a taxable entity on a 15-year triple- net lease. Exhibit 4 shows cash flows for a new building constructed and held for 15 years by the nonprofit research performer.

All cash flows are assumed to come at the end of each year, then inflows are netted against outflows. The cash flows are then discounted back to Time 0 at a discount rate of 9%. The discounted cash flows result in a net present cost or net present value at Time 0. For Exhibits 1-4, these discounted flows are equalized to produce a Time-Adjusted Annual Cash Flow Equivalent, which is the 15-year annuity which would have same net present cost or value as the cash flows shown.

Exhibit 1

HOSPITAL PROFORMA

TURN-KEY SUBLEASE FROM DEVELOPER

This case assumes that the developer signs a 15-year lease for shell space. The lease is triple-net with small escalations after Years 5 and 10. The developer approaches the Director of Research Administration at a medium-sized teaching hospital and offers to produce a turn-key laboratory in the shell space after 6 months of construction. The hospital would have to agree to sign on for the remaining 14.5 years of the base lease.

The developer has approached a local commercial bank with whom he has done business before. The bank is interested in establishing a relationship with the hospital. The lender, comfortable with the developer's expertise in lab construction and with the hospital's credit and future prospects, agrees to finance all of the developer's initial costs. This includes the base lease payments during the construction period, all construction costs, and even the developer's 8% fee. The bank writes a 15-year self-amortizing mortgage secured by the hospital's ability to pay rent.

The hospital's rental rate is calculated by adding the developer's base lease payment to the developer's mortgage payment, then multiplying by a debt coverage ratio with which the lender feels comfortable. The hospital would also

be responsible for paying property taxes above the base year amount.

For ease of illustration the Exhibit assumes that the all of the hospital's research fund sources are paying full indirect cost reimbursement, as the NIH would. Under OMB guidelines, the hospital's operating lease payments for its research facility qualify as reimbursable indirect costs of supporting research. The hospital would be reimbursed periodically for its lease payments. Thus, under this scenario, the hospital's cash position is completely neutral.

The biggest drawback from the hospital's perspective would be the loss of control of the space at the end of the term. There is also the risk of major upheavals in the research funding environment. For example, because property tax and developer profit are rolled into the hospital's lease payment, the institution will likely be at the higher end of the indirect cost percentage spectrum. Should OMB decide to cap indirect cost rates, or award grants with consideration for cost efficiency, the hospital's research program could suffer.

EXHIBIT 1
ASSUMPTIONS--TURN-KEY SUBLEASE FROM DEVELOPER

LEASE TERMS--DEVELOPER

Developer lease (GSF)		20,000
Lease term (yrs)		15
Lease rate ($/GSF/yr) Yr 1-5		$5.00
% Bump (Yr 6, 11)		10.0%
Lease start date	Time	0
Lease end date	Time	15
Property tax rate ($/GSF/yr) Yr 1		$1.25
Property tax rate ($/GSF/yr) Yr 2-4		$2.50
Property tax bump (%) Yr 5,8,11,14		15.00%

PROJECT COSTS		$/GSF	TOTAL
Hard project costs		$105.00	2,100,000
Soft project costs (not incl interest)		20.00	400,000
Major movable equipt costs		25.00	500,000
Total construction costs		150.00	3,000,000
Developer's fee (%)	8.00%	12.00	240,000
Total project costs		$162.00	3,240,000

CONSTRUCTION/PERMANENT LOAN

Developer loan term (yrs)		15
Developer downpayment		0.0%
Construction period (months)		6
Constr. per. ave. bal. (% of tot. cost)		50%
Interest rate (annual %)		9.5%
Total costs	3,240,000	
Less: downpayment	0	-
Total costs to be financed	3,240,000	=
Construction period interest	76,950	+
Construction period rent	50,000	+
Developer loan principal	3,366,950	=
Loan payment (annual)	$430,107	
Debt coverage ratio	1.15	

HOSPITAL SUBLEASE

Hospital sublease (GSF)		20,000
Hospital sublease term (yrs)		14.5
Sublease start date	Time	0.5
Sublease end date	Time	15
Property tax allowance ($/GSF/yr)		$2.50

	$/GSF	ANNUAL TOTAL
Hospital lease rate (first 4.5 yrs) DC ratio X (loan payt + lease payt)	30.48	609,623
Lease rate (next 5 yrs)	31.06	621,123
Lease rate (last 5 yrs)	31.69	633,773

HOSPITAL INCOME

Lab opening date	Time	0.5
Research volume ($/GSF/yr) Yr 1		$100.00
Research volume ($/GSF/yr) Yr 2		$120.00
Research volume ($/GSF/yr) Yr 3		$150.00
Research volume growth (%/yr) Yrs 4-15		5.0%
Full reimbursement %		100.0%
Discount rate (%)		9.0%

EXHIBIT 1 (CONTINUED)
HOSPITAL PROFORMA - TURN-KEY SUBLEASE FROM DEVELOPER

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CASH OUTFLOWS															
Hospital base lease payments	304,811	609,623	609,623	609,623	609,623	621,123	621,123	621,123	621,123	621,123	633,773	633,773	633,773	633,773	633,773
Property tax due	12,500	50,000	50,000	50,000	57,500	57,500	57,500	66,125	66,125	66,125	76,044	76,044	76,044	87,450	87,450
Less: property tax allowance	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Hospital property tax payment	0	0	0	0	7,500	7,500	7,500	16,125	16,125	16,125	26,044	26,044	26,044	37,450	37,450
Total hospital lease payments	304,811	609,623	609,623	609,623	617,123	628,623	628,623	637,248	637,248	637,248	659,816	659,816	659,816	671,223	671,223
Total cash outflows	304,811	609,623	609,623	609,623	617,123	628,623	628,623	637,248	637,248	637,248	659,816	659,816	659,816	671,223	671,223
CASH INFLOWS															
Total indirect cost reimbursement	304,811	609,623	609,623	609,623	617,123	628,623	628,623	637,248	637,248	637,248	659,816	659,816	659,816	671,223	671,223
Total cash inflows	304,811	609,623	609,623	609,623	617,123	628,623	628,623	637,248	637,248	637,248	659,816	659,816	659,816	671,223	671,223
NET CASH FLOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRESENT VALUE OF CASH FLOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET PRESENT COST TO HOSPITAL	0														
TIME ADJUSTED ANN'L CASH FLOW EQUIV'T	0														
HOSPITAL RESEARCH VOLUME (DIRECT)	1,000,000	2,400,000	3,000,000	3,150,000	3,307,500	3,472,875	3,646,519	3,828,845	4,020,287	4,221,301	4,432,366	4,653,985	4,886,684	5,131,018	5,387,569
REIMBURSEMENT-% OF DIRECT COSTS	30.5%	25.4%	20.3%	19.4%	18.7%	18.1%	17.2%	16.6%	15.9%	15.1%	14.9%	14.2%	13.5%	13.1%	12.5%

EXHIBIT 1 (CONTINUED)

Exhibit 2

HOSPITAL PROFORMA

HOSPITAL LEASES SHELL, BUILDS IMPROVEMENTS

INTEREST COSTS NOT RECOVERABLE

The scenario depicted in Exhibit 2 assumes that the hospital has gone directly to the owner of the shell space and secured a 15-year lease agreement exactly like the one the developer secured in the previous Exhibit. Once again, construction will require a period of 6 months, during which base lease payments and property taxes are due.

Unlike the developer, the hospital will not fully leverage the project. The 25% downpayment is assumed to be drawn from the endowment or cash reserve. If the downpayment was generated through a gift campaign, it could be argued that the financial analysis should not consider that a cash outflow.

The hospital's reimbursement is calculated by depreciating the building finish over the term of the lease, equipment over 8 years, and adding those allowances to the base lease and property tax payments. Because of the initial cash outflows and the lack of interest recovery, cash flow is substantially negative in the early years of the lease. This is not a favorable arrangement from the hospital's perspective.

EXHIBIT 2
ASSUMPTIONS -- HOSPITAL LEASES SHELL, BUILDS IMPROVEMENTS
INTEREST COSTS NOT RECOVERABLE

LEASE TERMS--HOSPITAL

Hospital lease (GSF)		20,000
Lease term (yrs)		15
Lease rate ($/GSF/yr) Yr 1-5		$5.00
% Bump (Yr 6, 11)		10.0%
Lease start date	Time	0
Lease end date	Time	15

PROJECT COSTS	$/GSF	TOTAL
Building shell costs	$0.00	0
Building finish costs	125.00	2,500,000
Major movable equipt costs	25.00	500,000
Total costs (not incl. interest)	150.00	3,000,000

CONSTRUCTION/PERMANENT LOAN

Hospital loan term (yrs)		15
Hospital downpayment (%)		25%
Construction period (months)		6
Constr. per. ave. bal. (% of tot. cost)		50%
Interest rate (annual %)		9.5%
Total costs	3,000,000	
Less: Downpayment	750,000	-
Total costs to be financed	2,250,000	=
Construction period interest	53,438	+
Construction period rent	50,000	+
Hospital loan principal	2,353,438	=
Loan payment (annual)	305,525	

USEFUL LIVES

Building shell useful life (yrs)	n/a
Building finish useful life (yrs)	15.0
Major movable equipt useful life (yrs)	8

PROPERTY TAXES

Property tax rate ($/GSF/yr) Yr 1	$1.25
Property tax rate ($/GSF/yr) Yr 2-4	$2.50
Property tax bump (%) Yr 5,8,11,14	15.0%

HOSPITAL INCOME

Lab opening date	Tim	0.5
Research volume ($/GSF/yr) Yr 1		$100.00
Research volume ($/GSF/yr) Yr 2		$120.00
Research volume ($/GSF/yr) Yr 3		$150.00
Research volume growth (%/yr) Yrs 4-15		5.0%
Full reimbursement %		100.0%
Discount rate		9.0%

EXHIBIT 2 (CONTINUED)
HOSPITAL PROFORMA - HOSPITAL LEASES SHELL, BUILDS IMPROVEMENTS
INTEREST COSTS NOT RECOVERABLE

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CASH OUTFLOWS															
Downpayment (Yr 1)	750,000														
Base lease payment	50,000	100,000	100,000	100,000	100,000	110,000	110,000	110,000	110,000	110,000	121,000	121,000	121,000	121,000	121,000
Property taxes due	25,000	50,000	50,000	50,000	57,500	57,500	57,500	66,125	66,125	66,125	76,044	76,044	76,044	87,450	87,450
Mortgage payment	152,763	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525
Interest expense	111,788	219,684	211,529	202,599	192,821	182,115	170,391	157,553	143,495	128,103	111,247	92,791	72,581	50,451	26,219
Principal repayment	40,974	85,841	93,996	102,926	112,704	123,411	135,135	147,973	162,030	177,423	194,278	212,734	232,944	255,074	279,306
Mortgage balance	2,312,463	2,226,622	2,132,625	2,029,700	1,916,996	1,793,585	1,658,450	1,510,478	1,348,448	1,171,025	976,747	764,012	531,068	275,994	(3,312)
Total cash outflows	977,763	455,525	455,525	455,525	463,025	473,025	473,025	481,650	481,650	481,650	502,569	502,569	502,569	513,976	513,976
CASH INFLOWS															
Base lease + property tax payments	75,000	150,000	150,000	150,000	157,500	167,500	167,500	176,125	176,125	176,125	197,044	197,044	197,044	208,450	208,450
Deprec. allowance: building finish	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667
Deprec. allowance: equipment	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	0	0	0	0	0	0	0
Total cash inflows	304,167	379,167	379,167	379,167	386,667	396,667	396,667	405,292	342,792	342,792	363,710	363,710	363,710	375,117	375,117
NET CASH FLOW	(673,596)	(76,359)	(76,359)	(76,359)	(76,359)	(76,359)	(76,359)	(76,359)	(138,859)	(138,859)	(138,859)	(138,859)	(138,859)	(138,859)	(138,859)
PRESENT VALUE OF CASH FLOW	(617,978)	(64,270)	(58,963)	(54,094)	(49,628)	(45,530)	(41,771)	(38,322)	(63,934)	(58,655)	(53,812)	(49,369)	(45,293)	(41,553)	(38,122)
NET PRESENT COST TO HOSPITAL	(1,321,295)														
TIME ADJUSTED ANN'L CASH FLOW EQUIV'T	(163,918)														
HOSPITAL RESEARCH VOLUME (DIRECT)	1,000,000	2,400,000	3,000,000	3,150,000	3,307,500	3,472,875	3,646,519	3,828,845	4,020,287	4,221,301	4,432,366	4,653,985	4,886,684	5,131,018	5,387,569
REIMBURSEMENT-% OF DIRECT COSTS	30.4%	15.8%	12.6%	12.0%	11.7%	11.4%	10.9%	10.6%	8.5%	8.1%	8.2%	7.8%	7.4%	7.3%	7.0%

Exhibit 3

HOSPITAL PROFORMA

HOSPITAL LEASES SHELL, BUILDS IMPROVEMENTS

INTEREST COSTS RECOVERABLE

Exhibit 3 shows the results of successful negotiation with the HHS auditor over the allowability of interest payments as an indirect cost. Because the interest expense is now being reimbursed, there are actually some positive annual cash flows during the first half of the lease. Both the hospital and the hospital's lender will be more comfortable with this arrangement.

One cause for concern here is the fairly high indirect cost rate during the early years, which could be problematic if research sponsors attempt to trim their costs in the future.

EXHIBIT 3
ASSUMPTIONS -- HOSPITAL LEASES SHELL, BUILDS IMPROVEMENTS
INTEREST COSTS RECOVERABLE

LEASE TERMS--HOSPITAL

Hospital lease (GSF)		20,000
Lease term (yrs)		15
Lease rate ($/GSF/yr) Yr 1-5		$5.00
% Bump (Yr 6, 11)		10.0%
Lease start date	Time	0
Lease end date	Time	15

PROJECT COSTS	$/GSF	TOTAL
Building shell costs	$0.00	0
Building finish costs	125.00	2,500,000
Major movable equipt costs	25.00	500,000
Total costs (not incl. interest)	150.00	3,000,000

CONSTRUCTION/PERMANENT LOAN

Hospital loan term (yrs)		15
Hospital downpayment (%)		25%
Construction period (months)		6
Constr. per. ave. bal. (% of tot. cost)		50%
Interest rate (annual %)		9.5%
Total costs	3,000,000	
Less: Downpayment	750,000	-
Total costs to be financed	2,250,000	=
Construction period interest	53,438	+
Construction period rent	50,000	+
Hospital loan principal	2,353,438	=
Loan payment (annual)	305,525	

USEFUL LIVES

Building shell useful life (yrs)	n/a
Building finish useful life (yrs)	15.0
Major movable equipt useful life (yrs)	8

PROPERTY TAXES

Property tax rate ($/GSF/yr) Yr 1	$1.25
Property tax rate ($/GSF/yr) Yr 2-4	$2.50
Property tax bump (%) Yr 5,8,11,14	15.0%

HOSPITAL INCOME

Lab opening date	Time	0.5
Research volume ($/GSF/yr) Yr 1		$100.00
Research volume ($/GSF/yr) Yr 2		$120.00
Research volume ($/GSF/yr) Yr 3		$150.00
Research volume growth (%/yr) Yrs 4-15		5.0%
Full reimbursement %		100.0%
Discount rate		9.0%

EXHIBIT 3 (CONTINUED)
HOSPITAL PROFORMA - HOSPITAL LEASES SHELL, BUILDS IMPROVEMENTS
INTEREST COSTS RECOVERABLE

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CASH OUTFLOWS															
Downpayment (Yr 1)	750,000														
Base lease payment	50,000	100,000	100,000	100,000	100,000	110,000	110,000	110,000	110,000	110,000	121,000	121,000	121,000	121,000	121,000
Property taxes due	25,000	50,000	50,000	50,000	57,500	57,500	57,500	66,125	66,125	66,125	76,044	76,044	76,044	87,450	87,450
Mortgage payment	152,763	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525	305,525
Interest expense	111,788	219,684	211,529	202,599	192,821	182,115	170,391	157,553	143,495	128,103	111,247	92,791	72,581	50,451	26,219
Principal repayment	40,974	85,841	93,996	102,926	112,704	123,411	135,135	147,973	162,030	177,423	194,278	212,734	232,944	255,074	279,306
Mortgage balance	2,312,463	2,226,622	2,132,625	2,029,700	1,916,996	1,793,585	1,658,450	1,510,478	1,348,448	1,171,025	976,747	764,012	531,068	275,994	(3,312)
Total cash outflows	977,763	455,525	455,525	455,525	463,025	473,025	473,025	481,650	481,650	481,650	502,569	502,569	502,569	513,976	513,976
CASH INFLOWS															
Base lease + property tax payments	75,000	150,000	150,000	150,000	157,500	167,500	167,500	176,125	176,125	176,125	197,044	197,044	197,044	208,450	208,450
Deprec. allowance: building finish	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667	166,667
Deprec. allowance: equipment	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	0	0	0	0	0	0	0
Interest expense	111,788	219,684	211,529	202,599	192,821	182,115	170,391	157,553	143,495	128,103	111,247	92,791	72,581	50,451	26,219
Total cash inflows	415,955	598,851	590,696	581,766	579,488	578,781	567,057	562,844	486,287	470,894	474,958	456,501	436,292	425,568	401,336
NET CASH FLOW	(561,808)	143,325	135,170	126,241	116,463	105,756	94,032	81,194	4,637	(10,756)	(27,611)	(46,068)	(66,278)	(88,407)	(112,639)
PRESENT VALUE OF CASH FLOW	(515,420)	120,634	104,376	89,432	75,693	63,059	51,439	40,749	2,135	(4,544)	(10,700)	(16,379)	(21,618)	(26,456)	(30,924)
NET PRESENT COST TO HOSPITAL	(78,524)														
TIME ADJUSTED ANN'L CASH FLOW EQUIV'T	(9,742)														
HOSPITAL RESEARCH VOLUME (DIRECT)	1,000,000	2,400,000	3,000,000	3,150,000	3,307,500	3,472,875	3,646,519	3,828,845	4,020,287	4,221,301	4,432,366	4,653,985	4,886,684	5,131,018	5,387,569
REIMBURSEMENT-% OF DIRECT COSTS	41.6%	25.0%	19.7%	18.5%	17.5%	16.7%	15.6%	14.7%	12.1%	11.2%	10.7%	9.8%	8.9%	8.3%	7.4%

Exhibit 4

HOSPITAL PROFORMA

HOSPITAL CONSTRUCTS BUILDING

INTEREST COSTS RECOVERABLE

The scenario shown in Exhibit 4 differs in several ways from the shell leases discussed above. Because the structure is built and owned by a non-profit entity, no property taxes are assumed. In reality, the institution may be expected to make a payment in lieu of taxes to the municipality. As a new construction project, it will be one year from Time 0 before occupancy can occur. Once again the institution will put down 25% of the project cost, which of course is higher ($200/sf) because it is new construction.

Because of the interest cost recovery, cash flows are positive in the early years of the holding period. This occurs despite the relatively small useful life allowances on the building's shell (1/40 per yr.) and finishes (1/20 per yr.). The reason for the large, positive Net Present Value to the hospital is the assumption about appreciation of the asset. Unlike the lease scenarios detailed above, in this case there is a residual at the end of the holding period. This analysis assumes that the building's shell has appreciated by 9% per year over the holding period, and the finishes have depreciated on a straight-line basis over their 20-year useful life.

EXHIBIT 4
ASSUMPTIONS -- HOSPITAL CONSTRUCTS BUILDING
INTEREST COSTS RECOVERABLE

Building area (GSF)	20,000	
Holding period (yrs)	15	
PROJECT COSTS	**$/GSF**	**TOTAL**
Building shell costs	$50.00	1,000,000
Building finish costs	125.00	2,500,000
Major movable equipt costs	25.00	500,000
Total costs (not incl. interest)	200.00	4,000,000

CONSTRUCTION/PERMANENT LOAN		
Hospital loan term (yrs)	15	
Hospital downpayment (%)	25%	
Construction period (months)	12	
Constr. per. ave. bal. (% of tot. cost)	50%	
Interest rate (annual %)	9.5%	
Total costs	4,000,000	
Less: Downpayment	1,000,000	-
Total costs to be financed	3,000,000	=
Construction period interest	142,500	+
Hospital loan principal	3,142,500	=
Loan payment (annual)	415,024	

USEFUL LIVES	
Building shell useful life (yrs)	40
Building finish useful life (yrs)	20
Major movable equipt useful life (yrs)	8

HOSPITAL INCOME		
Lab opening date	Time	1
Research volume ($/GSF/yr) Yr 2		$110.00
Research volume ($/GSF/yr) Yr 3		$120.00
Research volume ($/GSF/yr) Yr 4		$150.00
Research volume growth (%/yr) Yrs 5-15		5.0%
Full reimbursement %		100.0%
Property appreciation rate (shell)		9.0%
Discount rate		9.0%

EXHIBIT 5 (CONTINUED)
DEVELOPER PROFORMA - TURN-KEY SUBLEASE

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CASH INFLOWS															
Sublessee rent		304,811	609,623	609,623	609,623	609,623	621,123	621,123	621,123	621,123	621,123	633,773	633,773	633,773	633,773
Property taxes due		25,000	50,000	50,000	50,000	57,500	57,500	57,500	66,125	66,125	66,125	76,044	76,044	76,044	87,450
Less: property tax allowance		50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Sublessee property tax payment		0	0	0	0	7,500	7,500	7,500	16,125	16,125	16,125	26,044	26,044	26,044	37,450
Total sublessee payments		304,811	609,623	609,623	609,623	617,123	628,623	628,623	637,248	637,248	637,248	659,816	659,816	659,816	671,223
Loan proceeds	3,366,950														
Total cash inflows	3,366,950	304,811	609,623	609,623	609,623	617,123	628,623	628,623	637,248	637,248	637,248	659,816	659,816	659,816	671,223
CASH OUTFLOWS															
Construction costs	3,000,000														
Construction period interest	76,950														
Base rent		100,000	100,000	100,000	100,000	100,000	110,000	110,000	110,000	110,000	110,000	121,000	121,000	121,000	121,000
Loan payment		430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107	430,107
Property taxes		25,000	50,000	50,000	50,000	57,500	57,500	57,500	66,125	66,125	66,125	76,044	76,044	76,044	87,450
Total cash outflows	3,076,950	555,107	580,107	580,107	580,107	587,607	597,607	597,607	606,232	606,232	606,232	627,150	627,150	627,150	638,557
NET CASH FLOWS	290,000	(250,295)	29,516	29,516	29,516	29,516	31,016	31,016	31,016	31,016	31,016	32,666	32,666	32,666	32,666
PRESENT VALUE OF CASH FLOWS	290,000	(229,629)	24,843	22,792	20,910	19,183	18,494	16,967	15,566	14,281	13,101	12,659	11,614	10,655	9,775
NET PRESENT VALUE	271,211														

Exhibit 5

DEVELOPER PROFORMA

TURN-KEY SUBLEASE

Exhibit 5 shows the cash flow to the developer for the turn-key sublease deal described under Exhibit 1. Because the developer is 100% financed including the development fee, this arrangement carries an infinite return. This analysis does not even take into account the tax advantages that will occur because of interest and depreciation charges against the rental income. With a credit tenant like the hospital in place, the developer could easily sell the income stream if he needed to take extra cash during the term of the lease.

Further examination of potential financial returns to developers is beyond the scope of this paper. The case studies presented earlier suggest that superior financial returns are available to developers in build-to-suit long-term lease situations. The selection of a stable institution with a commitment to research and an ability to compete for funding is imperative. The developer must then structure the deal to minimize his construction, financing, and operating cost risks.

EXHIBIT 5
ASSUMPTIONS--TURN-KEY SUBLEASE

LEASE TERMS--DEVELOPER

Developer lease (GSF)		20,000
Lease term (yrs)		15
Lease rate ($/GSF/yr) Yr 1-5		$5.00
% Bump (Yr 6, 11)		10.0%
Lease start date	Time	0
Lease end date	Time	15
Property tax rate ($/GSF/yr) Yr 1		$1.25
Property tax rate ($/GSF/yr) Yr 2-4		$2.50
Property tax bump (%) Yr 5,8,11,14		15.00%

PROJECT COSTS		$/GSF	TOTAL
Hard project costs		$105.00	2,100,000
Soft project costs (not incl interest)		20.00	400,000
Major movable equipt costs		25.00	500,000
Total construction costs		150.00	3,000,000
Developer's fee (%)	8.00%	12.00	240,000
Total project costs		$162.00	3,240,000

CONSTRUCTION/PERMANENT LOAN

Developer loan term (yrs)	15	
Developer downpayment	0.0%	
Construction period (months)	6	
Constr. per. ave. bal. (% of tot. cost)	50%	
Interest rate (annual %)	9.5%	
Total costs	3,240,000	
Less: downpayment	0	-
Total costs to be financed	3,240,000	=
Construction period interest	76,950	+
Construction period rent	50,000	+
Developer loan principal	3,366,950	=
Loan payment (annual)	$430,107	
Debt coverage ratio	1.15	x

HOSPITAL SUBLEASE

Hospital sublease (GSF)		20,000
Hospital sublease term (yrs)		14.5
Sublease start date	Time	0.5
Sublease end date	Time	15
Property tax allowance ($/GSF/yr)		$2.50

	$/GSF	ANNUAL TOTAL
Hospital lease rate (first 4.5 yrs) DC ratio X (loan payt + lease payt)	30.48	609,623
Lease rate (next 5 yrs)	31.06	621,123
Lease rate (last 5 yrs)	31.69	633,773
Discount rate (%)	9.0%	

EXHIBIT 4 (CONTINUED)
HOSPITAL PROFORMA - HOSPITAL CONSTRUCTS BUILDING
INTEREST COSTS RECOVERABLE

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CASH OUTFLOWS															
Downpayment (Yr 1)	1,000,000														
Mortgage payment	0	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024
Interest expense	0	298,538	287,471	275,354	262,085	247,556	231,646	214,226	195,150	174,262	151,389	126,344	98,919	68,889	36,007
Principal repayment	0	116,486	127,553	139,670	152,939	167,468	183,378	200,798	219,874	240,762	263,635	288,680	316,105	346,135	379,017
Mortgage balance	3,142,500	3,026,014	2,898,461	2,758,791	2,605,852	2,438,384	2,255,006	2,054,208	1,834,334	1,593,571	1,329,937	1,041,256	725,152	379,017	0
Total cash outflows	1,000,000	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024	415,024
CASH INFLOWS															
Deprec. allowance: building shell	0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Deprec. allowance: building finish	0	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000
Deprec. allowance: equipment	0	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	0	0	0	0	0	0
Interest expense	0	298,538	287,471	275,354	262,085	247,556	231,646	214,226	195,150	174,262	151,389	126,344	98,919	68,889	36,007
Total cash inflows	0	511,038	499,971	487,854	474,585	460,056	444,146	426,726	407,650	324,262	301,389	276,344	248,919	218,889	186,007
Residual: building shell															3,642,482
Undepreciated balance: building finish															750,000
NET CASH FLOW	(1,000,000)	96,014	84,947	72,830	59,561	45,032	29,122	11,702	(7,374)	(90,762)	(113,635)	(138,680)	(166,105)	(196,135)	4,163,465
PRESENT VALUE OF CASH FLOW	(917,431)	80,813	65,595	51,594	38,711	26,851	15,931	5,873	(3,395)	(38,339)	(44,037)	(49,306)	(54,180)	(58,693)	1,143,030
NET PRESENT COST TO HOSPITAL	263,016														
TIME ADJUSTED ANN'L CASH FLOW EQUIV'T	32,630														
HOSPITAL RESEARCH VOLUME (DIRECT)	0	2,200,000	2,400,000	3,000,000	3,307,500	3,472,875	3,646,519	3,828,845	4,020,287	4,221,301	4,432,366	4,653,985	4,886,684	5,131,018	5,387,569
REIMBURSEMENT-% OF DIRECT COSTS		23.2%	20.8%	16.3%	14.3%	13.2%	12.2%	11.1%	10.1%	7.7%	6.8%	5.9%	5.1%	4.3%	3.5%

EXHIBIT 5 (CONTINUED)

Chapter XIII

CONCLUSIONS

This paper set out to examine a small niche of the real estate market, the biomedical research facility. Because of the narrow market and the nature of the institutional users, the development industry has in the past been under-represented in the production of medical research space.

Demand for research space is driven by the availability of funds from government, industry, or philanthropies. Each sector has demonstrated a commitment to research support in the past. Future prospects for funding levels are at least fair and might be very good under certain political and economic conditions.

Academic research performers throughout the country are intent on fulfilling their research mission by remaining competitive for funding. To achieve this end, many will seek to upgrade or expand their facilities.

Opportunities for the development community to produce laboratory facilities for research institutions could occur if certain conditions exist:

1. Institutional growth is constrained by campus density and surrounding competing uses.
2. The institution is unable or unwilling to secure construction funds.
3. Occupancy cost reimbursement by the institution's research sponsors allows recovery of leasing costs.

4. The institution is able, if necessary, to persuade its investigators to perform their research at a site which is not immediately adjacent to the sites of their teaching and clinical duties.

Because of the specialized nature of the product, and the difficulty of the planning and design process, a developer who establishes a level of skill in producing these facilities will probably be faced with few competitors in a given market. Prudent deal structuring should result in excellent financial returns to the developer.

LIST OF INTERVIEWS

Aetna Realty Group
Nick Aponti

Bank of New England
James Sweeney

Boston Redevelopment Authority
John Avault--Deputy Director for Policy Development and Research
Larry Koff--Development Specialist

Beth Israel Hospital
Joan Pinck--Director of Research Administration
Michael Lanner--Assistant Director
Gene Wallace--Vice President of Finance
Frank Holmes--Director of Grants and Contracts

Boston University School of Medicine
John Sandson--Dean the School of Medicine
Ann Der Hagopian--Director of Grants & Contracts

Boston University School of Management
Gerald Wedig--Professor

Brigham & Womens Hospital
John Cupples--Vice President of Admin. Services

Childrens Hospital Medical Center
Carol Weinrib--Vice President

Childrens Hospital (Philadelphia)
Karen Duffy--Research Administrator

Columbia/Presbyterian Medical Center
Richard Sohn--Director of Grants & Contracts

Dana Farber Cancer Institute
Bernard Janicki--Director of Research
William Corbett--Research Administration

Ellenzweig, Moore and Associates, Inc.
Randall Imai--Associate

Harvard Medical School
Nick Johnson--Assistant Dean for Facilities and Administrative Services

Hospital Corporation of America
Barbara Sirochty--Director of Corp. Communications

Howard Hughes Medical Institute
Nelson Pleau
James Potter--Public Relations

Humana Corporation
Patrick Stone--Public Relations

Jung/Brannen Associates, Inc.
E. Crawley Cooper, AIA--Principal

Kennedy & Rossi, Inc.
Rich Presti--Business Manager

Massachusetts Biotechnology Research Park
Ray Quinlan--Director

Massachusetts Eye and Ear Infirmary
Patrick Capobianco--Director of Finance
John Slymon--Director of Research

Massachusetts General Hospital
Lawrence Martin--Assistant General Director
Kathy Robbins--Cost and Payment Administrator

Massachusetts Hospital Association
David Shabot--Vice President for Health Systems

New England Deaconess Hospital
Robert Pence--Director of Research
Joseph Flaherty--Office of Grants and Contracts

New England Medical Center
Frank Stout--Vice President of Research Admin.
Judith Kurland--VP of Strategic Planning
& Corporate Public Affairs
Floyd Lane--Director of Reimbursement

Rackemann, Sawyer, and Brewster
Michael O'Connell--Partner

The Raymond Group
Neil St. John Raymond--Principal
David Francis--Project Director

Snyder, Tepper, and Komen
Paul Hestrom--Partner

Tishman-Speyer/Mediq
Marty Hopwood--Partner
Judy Glos--Partner

Tufts University School of Medicine
Joseph Byrne--Associate Provost for Research

University of Maryland Medical School
Marjorie Wilson--Vice Dean

University of California at San Francisco Medical Center
Robert Ryan--Department of Resource Management

University of California at Los Angeles Medical Center
Renee Fortier--Capital Programs Analyst

University of Massachusetts Medical Center
George Clark--Director of Grants and Contracts

University of Minnesota
Richard Oszustowicz--Professor of Finance

University of Pennsylvania Medical School
Doug Strong--Director of Research Planning

U.S. Government Department of Health and Human Services
Walter Boland--Office of the Regional Director
John Strauck--Office of Procurement and Logistics

Whitehead Institute for Biomedical Research
Cheryl Cathcart-Maxim--Director of Sponsored Programs

BIBLIOGRAPHY

American Hospital Association
Guide to the Healthcare Field, Chicago 1986

Bayless, Mark E. and Diltz, J. David, "Leasing Strategies Reduce the Cost of Financing Healthcare Equipment"
Healthcare Financial Management, October 1985

Beardsley, Tim
"Winners and losers worry aboutGramm-Rudman"
Nature, Vol. 322, p. 487, August 7, 1986

Berriman, W. Thomas, ed. "Capital Projects"
Topics in Healthcare Financing, Vol. 2, No. 2, Winter 1975

Braybrooke, Susan, ed.
Design for Research--Principles of Laboratory Architecture
John Wiley & Sons. New York 1986

Bryant, L. Edward, Jr., et al
"Roundtable on Capital Financing"
Healthcare Financial Management, August 1986

Carr, Lynch Associates
"Children's Hospital--PDA: Long-Range Plan"
Submitted to the Boston Redevelopment Authority April 1987

Cherskov, Myk
"Research and development facilities attract money"
Hospitals, February 20, 1987, p. 62

Cleverley, William O., "Assessing Present and Future Capital Expense Levels under PPS"
Healthcare Financial Management, September 1986

Crawford, Mark
"Tax Reform Package Jars University, R & D Sectors"
Science, Vol. 233, p. 935, August 29, 1986

Crawford, Mark
"R & D Budgets: Congress Leaves a Parting Gift"
Science, Vol. 234, p. 536, October 31, 1986

Culliton, Barbara J.
"Pressure to Cut the Deficit Creates Uncertainty forBiomedical Research"
Science, Vol. 232, p. 564, May 2, 1986

Culliton, Barbara
"Congress Boosts NIH Budget 17.3%"
Science, Vol. 234, p. 808, November 14, 1986

Culliton, Barbara
"Hughes Settles with IRS"
Science, Vol. 235, p. 1318

Denaro, Deborah and Gendron, Marie
"Hospitals hurting for space"
The Boston Business Journal, p. 1, April 6, 1987

Eastaugh, Steven R.
Medical Economics and Health Finance. Boston:
Auburn House. 1981

Ellenzweig, Moore and Associates, Inc., Architects
Brochure for Earl S. Tupper Research Institute, 1986

Facility Planning Office, The Children's Hospital
"Research Expansion Update", June 1987

Fudenburg, H. Hugh, ed.
Biomedical Institutions, Biomedical Funding, and Public Policy
New York: Plenum Press. 1983

Gannes, Stuart
"The Big Boys Are Joining The Biotech Party"
Fortune, July 6, 1987

Garg, Mohan L. and Barzansky, Barbara M., eds.
The Medicare System of Prospective Payment--Implications for Medical Education and Practice.
New York: Praeger. 1986

Moody, Frank G., MD "Clinical Research in the Era of Cost Containment"
The American Journal of Surgery, Vol. 153, April 1987

National Institutes of Health
The NIH Data Book, 1986

National Institutes of Health
Research Grant Directory, Bethesda 1985

Norman, Colin
"NIH Gets a Friendly Hearing on Capitol Hill"
Science, Vol. 231, March 21, 1986

Norman, Colin
"Deficits Haunt Science Budgets"
Science, Vol. 233, p. 928, August 29, 1986

Norman, Colin
"Science Budget: More of the Same"
Science, Vol. 235, p. 151, January 9, 1987

Norman, Colin
"Budget Details Released"
Science, Vol. 235, p. 628, January 23, 1987

Office of Management and Budget
"Circular A-21--Cost Principles for Educational Institutions"
Federal Register, Vol. 44, No. 45, March 6, 1979

Office of Management and Budget
"Circular A-21--Cost Principles for Educational Institutions"
Federal Register, Vol. 47, No. 149, August 3, 1982

Palca, Joseph, and Beardsley, Tim
"US administration plans budget increases for basic research"
Nature, Vol. 325, p. 96, January 8, 1987

Snook, I. Donald, Jr.
Hospitals: What They Are and How They Work.
Rockville, MD: Aspen. 1981

"Construction/Architects Survey"
Modern Healthcare, February 27, 1987

"OMB Slashes NIH Budget for FY 88"
Science, Vol. 234, p. 1494, December 19, 1986

"Research centre gets fixed home"
Nature, Vol. 324, p. 400, December 4, 1986